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CHILDHOOD MORTALITY *from* RHEUMATIC FEVER *and* HEART DISEASES

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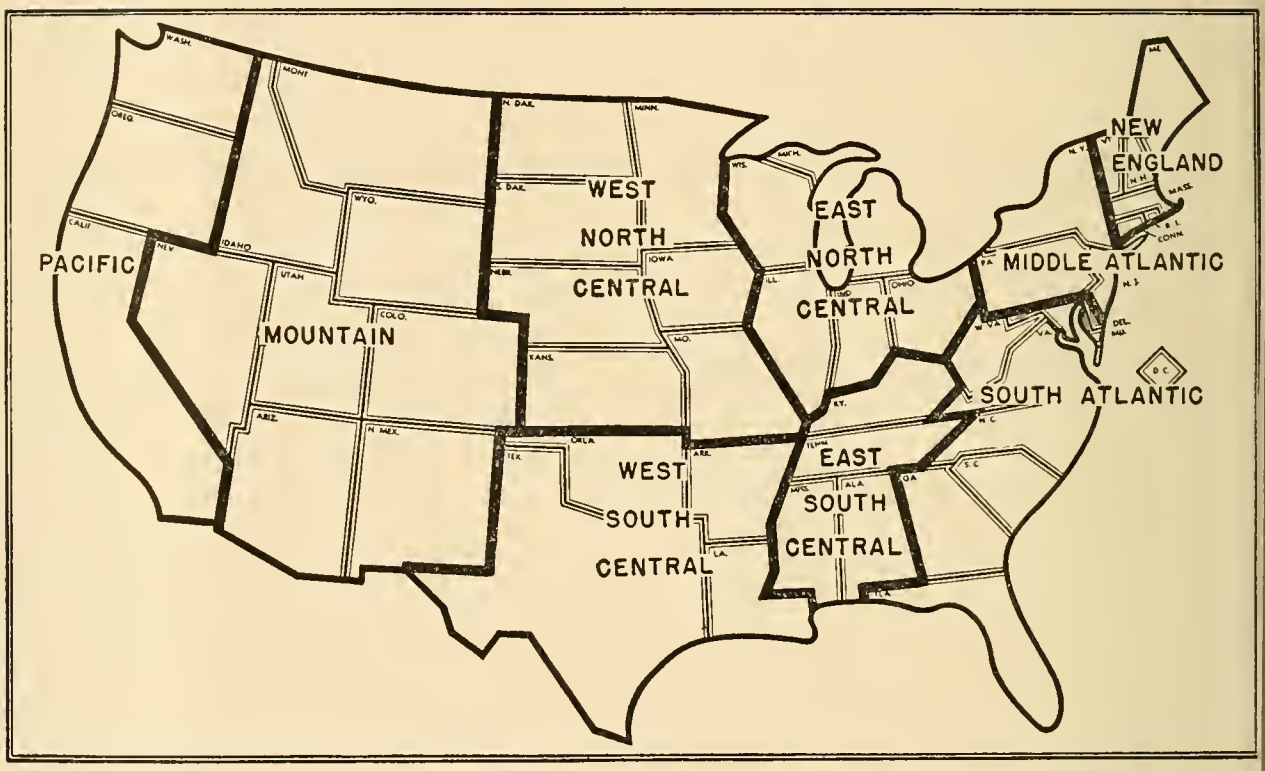

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CHILDHOOD MORTALITY FROM RHEUMATIC FEVER AND HEART DISEASES

A Statistical-Epidemiological Investigation into Differential Mortality by Age, Race, and Sex in the United States, its Geographic Divisions, and Individual States

I. Introduction

In recent years, rheumatic fever and its consequences, including chronic diseases of the heart, have been receiving more and more attention from pediatricians and public health workers (1). It is the opinion of clinical experts that between 80 and 90 percent of all deaths from heart diseases among children 5–19 years of age are due to rheumatic infection (Wyckoff and Lingg (2), Wilson (3), Hedley (4), Huse (5), Keith and Pequegnat (6), etc.). Heart diseases, including acute rheumatic affections, have become one of the leading causes of death among school-age children and adolescents, since the decline of the genuine acute infectious diseases of childhood (diphtheria, scarlet fever, measles, whooping cough, etc.) and of tuberculosis. In fact, in some recent years deaths of rheumatic origin in the United States have exceeded deaths from pneumonia and influenza combined. Certainly fatal accidents are much commoner than deaths from heart disease in childhood (7), but accident prevention does not represent an essentially medical problem and must be attacked by other means (traffic regulations, safety measures, etc.), which fall to a large extent in the realm of public education. For these reasons the campaign against rheumatic fever must be considered one of the outstanding tasks of public health.

Because of the increasing significance of rheumatic fever and its aftereffects for preventive medicine and public health (8, 9, 10, 11), a new statistical survey seems justified in that it will shed more light on the differentials in mortality by age, race, and sex in the United States, its geographic subdivisions and individual States. The testing of these differences by statistical methods is an essential part of the present investigation. The differentiation of the basic material as obtained from the Vital Statistics publications of the United States Bureau of the Census (12), has been prepared in the Children's Bureau for the 3-year period 1939–41. In order to diminish chance fluctuations, which must necessarily be large when the total is split into the respective age, race, and sex groups of the geographic subdivisions and individual States, the 3-year averages of the mortality data have been taken and centered on the enumerated population of the census of 1940. In the chapter on trend for the 3-year periods, 1919–21, 1929–31, and 1939–41, additional data for 1942, 1943, and 1944 have been given.

This study of differential mortality was originally intended solely as a statistical-epidemiological survey on the subject of rheumatic fever and heart diseases in childhood throughout the United States; but in the course of the investigation it became necessary to find out and discuss special statistical methods most appropriate to demonstrate, for the finer analysis, the significance of the numerous differences between the races, sexes, and geographic units, without too great expenditure in time and labor. It is hoped that the methods used here will be applied for the nation-wide analysis of other causes of death as well.

A statistical analysis of mortality rates can be valid only so far as the information supplied by the death certificates is accurate. There is no doubt that diagnostic and reporting facilities vary in different parts of the country. Some deaths actually due to heart disease are listed under other causes, and vice versa. But it can be hoped that errors of this kind are not frequent enough to invalidate our vital-statistics records.

Accepting the information as recorded, the out-

standing results of this study in differential mortality from rheumatic fever and heart diseases in childhood may be summarized as follows:

1. *Relative importance among other leading causes of death.*—The great weight that rheumatic fever plus heart diseases carries among the other leading causes of death in childhood is manifest in all three age groups from 5 through 19; disregarding accidents, it has become the leading cause among all diseases for white boys and girls 10–14 years of age, and for white boys 15–19. In spite of these facts, it is gratifying to know that in the last decades the mortality rates show a distinct decrease. However, the decrease is consistent only for white children; for nonwhite children the downward trend is not so consistent and less marked.

2. *Age differential.*—Disregarding the group of preschool children (under 5 years), with increasing age there is a distinct increase in the death rates for rheumatic fever and heart diseases in both sexes and both racial groups (white and nonwhite).

3. *Race (socio-economic) differential.*—Throughout the United States in almost all geographic divisions and individual States and in all age groups, whenever the death rates are based on large enough population numbers, the nonwhite children show a higher mortality for rheumatic heart diseases than the white children. Though this overmortality of the nonwhite group is not as great as in some other diseases which are aggravated by unfavorable socio-economic conditions (tuberculosis, syphilis), the pattern is sufficiently consistent throughout the United States in all age-sex groups to suggest strongly that rheumatic fever and heart diseases are also influenced by adverse conditions of the social environment. Similar conclusions have been advanced for England and Wales by Morris and Titmus (13) who, on basis of the Registrar's General occupational mortality statistics for five social-occupational classes, recognize juvenile rheumatism as one of the group of social diseases.

4. *Sex differential.*—There is little consistent or significant sex difference in mortality from rheumatic fever and heart diseases in the age groups 5–9 and 10–14, in either of the two racial groups. It is only in the group of adolescents, 15–19 years old, that a significant sex difference is found in both racial groups. In this age group, the white boys have higher death rates than the white girls; while on the other hand the nonwhite girls exhibit markedly higher death rates than the nonwhite boys. This high mortality of the young nonwhite females from heart disease is probably caused by their greater risks in early childbearing and thus resembles a similar situation in tuberculosis mortality.

4. *Geographic variations.*—There are certain variations in mortality from rheumatic fever and rheumatic heart afflictions in different parts of the country which cannot be attributed to mere chance. In general, the death rates in the South for both white and nonwhite children are below the respective averages for the total United States; in the Northeast, especially in the Middle Atlantic States, they are above. On the Pacific coast the rates are as low as in the South; while the Mountain States have extremely high rates for the white children, possibly due in part to the relatively large proportion there of population of Mexican origin for which socio-economic conditions are probably less favorable than for the remainder of the population classified as white.

Practical conclusions on how to carry on effectively the campaign against rheumatic fever and its aftereffects will be facilitated by detailed knowledge of where and when high or low mortality rates occur. From this point of view the differential death rates shown by age, race, and sex, as well as by geographic subdivisions and States, have a greater practical value than the combined rates of all ages and sexes (crude rates) in which the finer results are blurred. The differential rates show in detail where our efforts must be intensified to save the lives of our children.

II. Comparison With Other Leading Causes of Death

The importance of rheumatic fever as the principal cause of mortality from heart diseases in childhood has been stressed in recent discussions from all parts of the world and the different parts of the United States in particular (see 1, 14). It will be worth while considering the position which acute rheumatic fever and diseases of the heart combined at present occupies among the other leading causes of death. For this purpose table I has been prepared showing, for the period 1939–41 in total United States, the rank order of the six leading causes of death among the white and

nonwhite children by sex in the three important age groups, 5–9, 10–14, and 15–19 years.

Table I brings out very clearly the great weight that rheumatic fever plus heart diseases carries among the other leading causes of death in the different ages, the two racial groups, and the sexes, during childhood. If we leave out of consideration accidents, which in their sum are the leading cause but do not represent a genuine disease, rheumatic fever and its chronic aftereffects has tremendous importance in damaging and destroying the lives of our children. It has indeed become the leading or one of the leading causes of death among all diseases. The death rates for the different causes are shown in the table by order of the rate for males; the rank of the rate for females is shown in brackets.

Among white boys 5–9 years of age, the combined death rate for rheumatic fever and heart diseases, 7.6 per 100,000, is surpassed only by the combined death rate for pneumonia and influenza, 10.2, (combined according to the most usual classification of the National Office of Vital Statistics) and by appendicitis, 8.2. Among white girls of this age, mortality from rheumatic fever and heart diseases, 8.0 per 100,000, is second only to pneumonia and influenza which has a somewhat higher rate, 9.0. In the nonwhite group of this age the order is similar, except that tuberculosis enters the rank in both sexes in the second place after pneumonia and influenza (again disregarding accidents). Thus the death rates of the nonwhite boys and girls for rheumatic fever and diseases of the heart, 12.2 and 13.0, respectively, occupy the third place among genuine diseases.

In the age group of the older school child, 10–14 years, mortality from rheumatic heart diseases advances still further into the foreground; as a

Table I.—Rank of 6 leading causes of death in childhood, 5–19 years, by age, race, and sex. Average annual death rates per 100,000 population: United States, 1939–41

Leading causes of death in order of the rates for the white male	White		Leading causes of death in order of the rates for the nonwhite male	Nonwhite	
	Male	Female (rank in brackets)		Male	Female (rank in brackets)
			5–9 years		
Accidents (169–195)	39.3	20.0 (1)	Accidents (169–195)	42.6	26.7 (1)
Pneumonia and influenza (107–109, 33).	10.2	9.0 (2)	Pneumonia and influenza (107–109, 33).	21.2	18.1 (2)
Appendicitis (121)	8.2	6.7 (4)	Tuberculosis (13–22)	16.4	14.7 (3)
Rheumatic fever (58) and diseases of the heart (90–95).	2.1 / 5.5 / 7.6	2.4 / 5.6 / 8.0 (3)	Rheumatic fever (58) and diseases of the heart (90–95).	2.9 / 9.3 / 12.2	3.7 / 9.3 / 13.0 (4)
Diseases of the ear, nose, and throat (89, 104, 115).	5.3	4.7 (5)	Diseases of the nervous system (80–88).	6.4	5.3 (6)
Diseases of the nervous system (80–88).	4.9	4.1 (6)	Appendicitis (121)	5.8	5.6 (5)
			10–14 years		
Accidents	40.9	12.2 (1)	Accidents	56.2	14.5 (4)
Rheumatic fever and diseases of the heart.	2.4 / 8.8 / 11.2	2.5 / 9.2 / 11.7 (2)	Tuberculosis	22.3	39.0 (1)
Appendicitis	9.0	6.9 (4)	Pneumonia and influenza	17.4	16.3 (3)
Pneumonia and influenza	7.0	7.1 (3)	Rheumatic fever and diseases of the heart.	3.8 / 11.3 / 15.1	4.2 / 13.2 / 17.4 (2)
Diseases of the nervous system.	4.9	3.5 (5)	Appendicitis	10.1	7.2 (5)
Diseases of the ear, nose, and throat.	3.3	3.2 (6)	Diseases of the nervous system.	7.8	6.4 (6)
			15–19 years		
Accidents	74.1	19.8 (1)	Accidents	98.1	21.1 (5)
Rheumatic fever and diseases of the heart.	1.6 / 12.7 / 14.3	1.4 / 11.2 / 12.6 (3)	Tuberculosis	97.2	159.7 (1)
Appendicitis	11.2	6.6 (6)	Homicide (165–168)	36.4	15.2 (6)
Tuberculosis	10.7	18.9 (2)	Pneumonia and influenza	30.0	30.9 (3)
Pneumonia and influenza	10.4	7.5 (5)	Rheumatic fever and diseases of the heart.	2.2 / 15.7 / 17.9	2.2 / 21.6 / 23.8 (4)
Diseases of pregnancy (140–150).	----------	11.3 (4)	Diseases of pregnancy (140–150).	----------	62.3 (2)

NOTE.—The numbers in brackets after causes of death are those of the International List, Fifth Revision of 1938; they are not repeated in the different age groups when shown before.

matter of fact, among white children of both sexes the death rates, 11.2 and 11.7, respectively, are now leading among all diseases and are definitely above those for appendicitis as well as those for pneumonia and influenza, the next leading causes. For the nonwhite girls, tuberculosis occupies first place, even exceeding accidents, with rheumatic fever and diseases of the heart second. For the nonwhite boys rheumatic fever and diseases of the heart occupy the third place, pneumonia and influenza having, after tuberculosis, a somewhat higher rate. It will be noticed further that the respective death rates for rheumatic diseases in the two sexes, 15.1 and 17.4, show a definite excess of the female rate, as is the case, even more distinctly, for tuberculosis, with the respective death rates of 22.3 and 39.0 for the nonwhite boys and girls.

Again disregarding accidents, in the age group 15–19 years, among white boys rheumatic fever and heart diseases (14.3) take a definite lead over the other leading causes, appendicitis, tuberculosis, and pneumonia and influenza; among white girls the rate is somewhat lower (12.6) and is exceeded by tuberculosis (18.9), but still leaves pneumonia and influenza (7.5) far behind. In the nonwhite youth of this age the picture is somewhat different. The death rates for acute rheumatic fever and heart diseases, 17.9 for the boys and 23.8 for the girls, are higher than in the white group, showing again the characteristic excess of female mortality from rheumatic heart diseases among the nonwhite adolescents. But in both sexes these rates are far surpassed by those for tuberculosis, which is extremely high among the females (159.7). The second highest cause of death among nonwhite girls is diseases of pregnancy (62.3), followed at some distance by pneumonia and influenza (30.9) and then by rheumatic fever and heart diseases (23.8). The rank order is similar for the nonwhite boys, but with the noteworthy difference that here (again disregarding accidents) homicide occupies second place as a leading cause of death (36.4) following tuberculosis (97.2); pneumonia and influenza (30.0), too, occupy for the nonwhite male a place before rheumatic heart diseases (17.9).

From this summary comparison of the leading causes of death in childhood and youth it may be said for the white group that, with increasing age, deaths from rheumatic fever and diseases of the heart hold an increasingly high place among fatal diseases; while in the nonwhite group tuberculosis is by far the greatest killer, especially for girls entering the childbearing age.

III. Time Trend of Rheumatic Fever Mortality in the United States Between the Two World Wars

Data are available for the 3-year periods 1929–31 and 1919–21, based upon the preceding censuses of 1930 and 1920, which can be compared with the later period 1939–41 of the present survey. Table IIa covers the time span between the two World Wars, from 1919–21 to 1939–41. Data for the following single years, 1942, 1943, and 1944, are added to bring the material up to date as far as possible (15, 16). All these data concern the total United States or, in the former periods, the death registration States which were then included in the registration area.

Since among the causes of death the item, chronic rheumatic diseases of the heart, had not been segregated as a special subdivision of heart diseases before the fifth revision (1938) of the International List of Causes of Death, rates in this chapter are shown only for acute rheumatic fever and all diseases of the heart, to make comparison possible over the whole time span. Furthermore, as explained in more detail later (pp. 8–10), the new subdivision, chronic rheumatic diseases of the heart, according to clinical experts, gives an understatement of deaths during the childhood years, 5–19, from all fatal cardiac lesions of rheumatic etiology. A combination of acute rheumatic fever with all heart diseases, or with a percentage as high as 90, gives a better idea of the death toll from rheumatic fever and its aftereffects in childhood.

The most impressive result from table IIa, which shows the trend for all three age groups and for both sex and race groups, is the distinct decrease over the past decades in mortality among white children. This is in agreement with a recent report by the Metropolitan Life Insurance Co. (17) for the white children, 1 to 14 years, of its policyholders in the United States and Canada. In that report all the more important causes of death in childhood are listed in 5-year averages

of the annual death rates from 1911–15 to 1941–45, with their percentage decrease over the period shown. In the Metropolitan investigation of the insured children, the decrease for acute rheumatic fever and for organic diseases of the heart amounted to more than 70 percent among both boys and girls over the whole period, which is somewhat different from the period covered in our investigation. However, the results are similar. The decrease in our survey is best shown by the relative figures in our table expressed as percentages of the rates in 1919–21. The relative figures are mostly

Table 11a.—Death rates for acute rheumatic fever and diseases of the heart in children, 5–19 years, by age, race, and sex: United States death registration States, 1919–21, 1929–31, 1939–41, 1942, 1943, and 1944

[Also relative figures showing the percentage decrease or increase]

Years, cause of death	White						Nonwhite					
	5–9 years		10–14 years		15–19 years		5–9 years		10–14 years		15–19 years	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
	Average annual rates per 100,000											
1919–21												
Acute rheumatic fever	4.4	4.1	4.5	5.3	3.5	3.6	2.3	2.2	2.5	3.7	3.7	3.5
Diseases of the heart	14.2	15.2	18.8	23.9	23.2	23.3	8.2	10.1	14.8	18.1	22.1	30.7
1929–31												
Acute rheumatic fever	3.0	2.9	3.1	3.2	2.3	2.3	2.1	2.9	3.3	3.2	2.7	3.2
Diseases of the heart	9.6	10.6	13.4	16.4	18.5	18.4	9.6	10.4	12.9	15.0	21.1	28.2
1939–41												
Acute rheumatic fever	2.1	2.4	2.4	2.6	1.7	1.4	2.9	3.7	3.8	4.2	2.2	2.2
Diseases of the heart	5.5	5.6	8.8	9.2	12.7	11.2	9.3	9.3	11.3	13.2	15.7	21.6
1942												
Acute rheumatic fever	1.8	1.8	1.8	2.1	1.3	1.4	2.6	3.7	3.8	3.6	2.1	1.9
Diseases of the heart	4.3	4.4	6.9	6.9	11.4	10.4	7.5	8.7	12.0	10.9	15.0	19.8
1943												
Acute rheumatic fever	1.6	1.4	1.7	1.9	1.3	1.4	3.3	2.9	2.8	2.6	1.8	2.7
Diseases of the heart	4.0	4.6	7.0	7.7	11.4	9.8	4.8	7.1	11.5	13.5	15.5	23.6
1944												
Acute rheumatic fever	1.7	1.5	2.0	2.1	1.9	1.4	2.9	3.8	3.3	3.8	2.8	1.4
Diseases of the heart	3.9	4.2	7.5	7.1	11.1	8.6	6.3	7.2	11.5	12.7	15.3	18.1
	Relative figures: Death rates, 1919–21=100											
1929–31												
Acute rheumatic fever	68	71	69	60	66	64	91	132	132	86	73	91
Diseases of the heart	68	70	71	69	80	79	117	103	87	83	95	92
1939–41												
Acute rheumatic fever	48	59	53	49	49	39	126	168	152	114	59	63
Diseases of the heart	39	37	47	38	55	48	113	92	76	73	71	70
1942												
Acute rheumatic fever	41	44	40	40	37	39	113	168	152	97	57	54
Diseases of the heart	30	29	37	29	49	45	91	86	81	60	68	64
1943												
Acute rheumatic fever	36	34	38	36	37	39	143	132	112	70	49	77
Diseases of the heart	28	30	37	32	49	42	59	70	78	75	70	77
1944												
Acute rheumatic fever	39	37	44	40	54	39	126	173	132	103	76	40
Diseases of the heart	27	28	40	30	48	37	77	71	78	70	69	59

below 50 in the period 1939–41, with smaller variations in the different age-sex groups of the white children. In the following years, 1942, 1943, and 1944, this epidemiological trend continues in the same direction, with the relative figures for diseases of the heart down to 27 and 28 for boys and girls, respectively, in the age group 5–9, and to 40 and 30 in the age group 10–14. This is very close to the results in the Metropolitan Life Insurance study. In the age group 15–19 (not covered by the latter study) the relative decrease in mortality from heart diseases is not quite so large, though in both sexes it is more than 50 percent, the relative figures in 1944 being 48 and 37 for boys and girls, respectively. Altogether it can be said that the decrease in mortality among white children from acute rheumatic fever and its chronic aftereffects on the heart is very encouraging. However, the decline is not as great as it is for most of the acute infectious diseases of childhood (such as diphtheria, scarlet fever, measles, whooping cough), or tuberculosis.

Moreover the story is very different for nonwhite children. Among nonwhite school-age children (5–9, 10–14 years) up to the last report in 1944, there is almost no decrease, in fact there is an apparent increase, in mortality from acute rheumatic fever, almost all index figures being above 100 (see table IIa). In the oldest groups of nonwhite children (15–19 years), a decrease in mortality from acute rheumatic fever is shown over the same period but it is smaller than the decrease for white children of this age. Even mortality from heart diseases for the nonwhite children aged 5–9 does not show any essential decrease up to the 3-year period 1939–41. A certain decline in rates for this cause of death is discernible in the subsequent years, 1942, 1943, and 1944, for the 5–9 year-old group. (It should be kept in mind that the death rates in single years, particularly for the nonwhite children, and the relative figures derived from them are not as well stabilized as for the 3-year averages. This becomes evident in the marked variation of rates for the nonwhite children in single calendar years.) Also some decline in mortality from diseases of the heart over the entire period reported is evident in the case of nonwhite children 10–14 years of age, but again the relative decrease is much less marked than for the corresponding white children. A consistent downward trend over the whole period for acute rheumatic fever as well as for heart diseases can be seen only in the oldest age group of the nonwhite children, 15–19 years. But even here the relative decrease in mortality from heart diseases is markedly behind that of the white adolescents, from 1919–21 to the last report in 1944; the relative figures being still 70 and 77 for the nonwhite boys and girls, respectively, in the year 1943 and 69 and 59 in 1944.

These data indicate that the rates for acute rheumatic fever mortality among younger nonwhite children (5–9, 10–14 years) apparently increased over the three decades and wherever gains in reduced mortality were made, either for acute rheumatic fever or for diseases of the heart, they were notably smaller than those made for white children.

How far these statistical results, though based on reasonably large numbers, reflect the true epidemiological trends of rheumatic fever among white and nonwhite children during recent decades is hard to decide. A possible explanation for the apparent upward trend in acute rheumatic fever mortality among young nonwhite children is that it represents an artificial product; the trend could well be explained by relatively deficient diagnostic services in the early decades of the century, making for an artificially low number of deaths attributed to rheumatic diseases among the nonwhite children. Such a suspicion is strengthened by our own figures which, in the 1920 period, show very low death rates for the nonwhite children, lower indeed in almost all instances than those for the white children. This is shown by relative figures in the supplementary table IIb, which gives the ratios of the death rates, nonwhite to white, for all age groups and both sexes.

In this table, taking the death rates of the white children as 100, the relative figures (nonwhite to white) in the period 1919–21 are in almost all instances below 100 for nonwhite children. The only exceptions are in the 15–19 year-old group; here the nonwhite boys show a somewhat higher mortality for acute rheumatic fever, and the nonwhite girls for diseases of the heart. Even in the following 3-year period, 1929–31, the death rates of the nonwhite children are below or equal to those of the white in several instances (except again in the 15–19 year group), as indicated by the relative figures. But these over-all results are contrary to more recent experience. *In 1939–41 the picture is greatly different; it is almost the inverse of that in 1919–21.* Here in all instances the nonwhite children exhibit higher mortality rates for acute rheumatic fever as well as for diseases of the heart, all relative figures being definitely above

100. This tendency to higher mortality for the nonwhite group continues in 1942, 1943, and 1944; such are the statistical findings throughout the United States, its geographic subdivisions, and individual States, as will be demonstrated in our detailed study for the period 1939–41.

Other general considerations support the supposition that the trends in mortality for the nonwhite group reflect to a large extent a change in the accuracy of diagnoses. For example, it is unlikely that the susceptibility of the nonwhite group towards rheumatic fever and its consequences, has increased in the period of 25 years. At the same time it is hardly reasonable to suppose that the availability and efficacy of medical treatment were more extensive for nonwhite children in 1919–21 than in 1939–41. Hence the most plausible explanation for the unusual trends found among the nonwhite children is the one mentioned above, namely, that the reliability of the medical diagnoses and their reporting on the death certificates has increased with the recent energetic campaign against rheumatic fever.

Table IIb.—Ratios of death rates, nonwhite to white, for acute rheumatic fever and diseases of the heart in children, 5–19 years, by age and sex: United States death registration States, 1919–21, 1929–31, 1939–41, 1942, 1943, and 1944

Years, cause of death	5–9 years		10–14 years		15–19 years	
	Male	Female	Male	Female	Male	Female
	Ratios: Death rates of white=100					
1919–21						
Acute rheumatic fever	52	54	56	70	106	97
Diseases of the heart	58	66	79	76	95	132
1929–31						
Acute rheumatic fever	70	100	106	100	117	139
Diseases of the heart	100	98	96	91	114	153
1939–41						
Acute rheumatic fever	138	154	158	162	129	157
Diseases of the heart	169	166	128	143	124	193
1942						
Acute rheumatic fever	144	206	211	171	162	136
Diseases of the heart	174	198	174	158	132	190
1943						
Acute rheumatic fever	206	207	165	137	138	193
Diseases of the heart	120	154	164	175	136	241
1944						
Acute rheumatic fever	171	253	165	181	147	100
Diseases of the heart	162	171	153	179	138	210

IV. Age, Race, and Sex Differences in Childhood Mortality From Acute Rheumatic Fever and Diseases of the Heart

A summary view of the basic mortality figures for rheumatic fever and heart diseases in the United States as a whole, 1939–41, is given in table III. The death rates per 100,000 population by age, race, and sex are computed separately for acute rheumatic fever (No. 58 of the International List of Causes of Death, 1938 Revision), chronic rheumatic diseases of the heart (Nos. 90a, 92b,c, 93c, 95b), and all diseases of the heart (Nos. 90–95). The race and sex differentials show some interesting similarities and differences which are still more distinctly illustrated by the ratios of the death rates, nonwhite to white and male to female, as shown in the same table. In table IV the absolute numbers of deaths are given as well as the population numbers in the corresponding groups by age, race, and sex for the United States, census of 1940. Since we deal with the deaths of 3 years, 1939, 1940, and 1941, the person-years exposed to risk is three times the

census population. Therefore, the obtained rates for the total United States are indeed based on huge population numbers in all age-race-sex groups.

The nomenclature of the International List as adopted for use in the United States (18), is followed in analyzing differential mortality rates for acute rheumatic fever and heart diseases. No. 58 of the International List of Causes of Death comprises all deaths from acute rheumatic heart disease and other forms of acute rheumatic fever. The subdivisions of this title are (a) acute rheumatic pericarditis, (b) acute rheumatic endocarditis, (c) acute rheumatic myocarditis, (d) other acute rheumatic heart diseases (such as rheumatic carditis or pancarditis), (e) other forms of acute rheumatic fever, and (f) rheumatism (not specified as acute or chronic). It can be assumed that practically all deaths in childhood counted in item 58 are caused by acute rheumatic heart afflictions; only a few are listed under other forms of acute rheumatic fever and rheumatism (No. 58e and f), and these deaths, too, are probably due to involvement of the heart even when this is not explicitly stated in the death certificates. Thus the item of deaths from acute rheumatic heart disease is well covered by this detailed subdivision of No. 58 in the International List.

Deaths from chronic rheumatic heart diseases, as given in the subdivisions (90a, 92b,c, 93c, 95b) of the entire group, diseases of the heart (90–95), includes the following specified diseases: chronic rheumatic pericarditis (90a), diseases of the mitral valve whether or not specified as rheumatic (92b), diseases of other and unspecified valves and chronic endocarditis specified as rheumatic (92c), chronic myocarditis and myocardial degeneration specified as rheumatic (93c), and other diseases of the heart specified as rheumatic (95b). To obtain an estimate of the total deaths due to rheumatic heart disease one would combine the numbers due to acute and to chronic heart diseases if the diagnoses of the physicians

Table III.—Childhood mortality from acute rheumatic fever, chronic rheumatic diseases of the heart, and diseases of the heart (all forms), by age, race, and sex: United States, 1939–41

Cause of death and race (Numbers of International List of Causes of Death, Fifth Revision of 1938)	Under 20 years		Under 5 years		5–9 years		10–14 years		15–19 years	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
	Average annual death rates per 100,000									
Acute rheumatic fever (58), all races	1.8	1.9	0.8	0.8	2.2	2.5	2.6	2.8	1.7	1.5
White	1.7	1.8	.7	.7	2.1	2.4	2.4	2.5	1.6	1.4
Nonwhite	2.4	2.9	.9	1.5	2.9	3.7	3.8	4.2	2.2	2.2
Chronic rheumatic diseases of the heart (90a, 92b, c, 93c, 95b), all races	4.2	4.2	1.0	1.0	3.2	3.4	5.4	6.0	6.7	6.0
White	4.1	4.0	.9	.8	3.0	3.2	5.3	5.8	6.7	5.7
Nonwhite	4.7	5.5	1.6	1.8	4.7	5.1	6.2	7.1	6.2	7.8
Diseases of the heart (all forms) (90–95), all races	8.9	8.8	6.9	6.3	6.0	6.1	9.0	9.7	13.1	12.4
White	8.6	8.2	6.7	5.9	5.5	5.6	8.8	9.2	12.7	11.2
Nonwhite	11.3	13.4	8.9	8.9	9.3	9.3	11.3	13.2	15.7	21.6
	Ratios: Nonwhite to white									
Acute rheumatic fever	1.4	1.6	1.3	2.1	1.4	1.5	1.6	1.7	1.4	1.6
Chronic rheumatic diseases of the heart	1.1	1.4	1.8	2.3	1.6	1.6	1.2	1.2	.9	1.4
Diseases of the heart (all forms)	1.3	1.6	1.3	1.5	1.7	1.7	1.3	1.4	1.2	1.9
	Ratios: Male to female									
Acute rheumatic fever:										
White	0.9		1.0		0.9		1.0		1.1	
Nonwhite	.8		.6		.8		.9		1.0	
Chronic rheumatic diseases of the heart:										
White	1.0		1.1		.9		.9		1.2	
Nonwhite	.9		.9		.9		.9		.8	
Diseases of the heart (all forms):										
White	1.0		1.1		1.0		1.0		1.1	
Nonwhite	.8		1.0		1.0		.9		.7	

on the death certificates were exact enough for a true evaluation of these conditions. However, careful clinical investigations seem to indicate that among the remaining chronic heart diseases, not specifically designated as rheumatic, a good many are of rheumatic origin, particularly among school-age children. It is more or less generally accepted that nearly all deaths attributed to heart disease in this age are caused by rheumatic fever. At one time some of the deaths attributed to heart disease were undoubtedly due to diphtheria or scarlet fever. But diphtheria has become extremely rare nowadays and if a diphtheria death does occur it is usually attributed directly to diphtheria, as Hedley (4) has pointed out. Scarlet fever, on the other hand, has become so mild a disease, even though still relatively frequent (Collins, 19), that death from this acute infection is extremely rare. It is therefore only in the preschool group of children under 5 years of age, among whom acute rheumatic fever and chronic rheumatic heart disease seldom appear as cause of death (see table III), that other heart diseases (congenital malformations of the heart and of the cardiovascular system) play a greater part.

These observations seem to justify the assumption of certain clinical experts that the majority of all deaths from heart diseases (approximately 90 percent), in children 5 years and over, is of rheumatic etiology. This being the case, the mere combination of the two groups, characterized as acute rheumatic fever and chronic rheumatic heart diseases, does not sufficiently cover the full amount of rheumatic fatalities. Hence we have added in the following tabulations, as a third group, all deaths from diseases of the heart (all forms). (It should be emphasized that the group, diseases of the heart (all forms), is inclusive of the subdivision, chronic rheumatic diseases of the heart.)

If we now glance at the death rates, separately computed for chronic rheumatic diseases of the heart and all heart diseases, it will be seen that for all persons under 20 years of age, in both sexes and races, the mortality from chronic rheumatic heart diseases is less than half the total mortality from

Table IV.—Deaths from acute rheumatic fever, chronic rheumatic diseases of the heart, and diseases of the heart (all forms) in persons under 20 years, by age, race, and sex: United States, 1939–41

ABSOLUTE NUMBERS FOR 3 YEARS

Cause of death and race (Numbers of International List of Causes of Death, Fifth Revision of 1938)	Under 20 years		Under 5 years		5–9 years		10–14 years		15–19 years	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Acute rheumatic fever (58), all races	1, 245	1, 293	121	130	352	402	456	478	316	283
White	1, 048	1, 052	103	100	294	327	378	389	273	236
Nonwhite	197	241	18	30	58	75	78	89	43	47
Chronic rheumatic diseases of the heart (90a, 92b, c, 93c, 95b), all races	2, 889	2, 834	162	150	520	542	967	1, 038	1, 240	1, 104
White	2, 509	2, 380	130	115	424	438	839	889	1, 116	938
Nonwhite	380	454	32	35	96	104	128	149	124	166
Diseases of the heart (all forms) (90–95), all races	6, 127	5, 910	1, 113	975	978	966	1, 616	1, 685	2, 420	2, 284
White	5, 216	4, 810	939	799	789	776	1, 381	1, 408	2, 107	1, 827
Nonwhite	911	1, 100	174	176	189	190	235	277	313	457

Population under 20 years, by age, race, and sex: United States Census of 1940

Age groups in years	All races		White		Nonwhite	
	Male	Female	Male	Female	Male	Female
Under 20	22, 906, 113	22, 399, 491	20, 220, 934	19, 654, 264	2, 685, 179	2, 745, 227
Under 5	5, 354, 808	5, 186, 716	4, 701, 470	4, 528, 035	653, 338	658, 681
5–9	5, 418, 823	5, 265, 799	4, 744, 537	4, 584, 414	674, 286	681, 385
10–14	5, 952, 329	5, 793, 606	5, 259, 007	5, 093, 688	693, 322	699, 918
15–19	6, 180, 153	6, 153, 370	5, 515, 920	5, 448, 127	664, 233	705, 243

heart diseases. Disregarding the age group under 5 years (because of the importance of congenital malformations of the heart and of the cardiovascular system as a cause of death in this age group), and considering only the three age groups, 5–9, 10–14, and 15–19 years, we find that deaths from chronic rheumatic diseases of the heart seldom account for more than 60 percent of the deaths from all heart diseases in any of the race-sex groups. This is probably an understatement of the loss of human life in childhood due to rheumatic afflictions. Therefore we prefer (as some former investigators have done) to take all deaths from heart diseases augmented by those from acute rheumatic fever, as a better estimate for the loss of children 5 years and older.

O. F. Hedley (4) in his comprehensive and comparative study on geographical and racial distribution of heart disease, covering the years from 1922 to 1936, took mortality from all heart diseases among persons 5–24 years of age as an "index of rheumatic heart disease mortality in the United States." At the time of his study it was not yet possible to separate statistically the deaths due to rheumatic heart diseases from those of other origin. Only in the last (fifth) revision of the International List of Causes of Death (1938) has a consistent attempt been made to segregate cardiac lesions of rheumatic origin as subdivisions under the various titles of heart diseases.

The absolute number of deaths estimated on the joint basis of those due to heart diseases (all forms) and to acute rheumatic fever will give a more concrete idea of the amount of human life lost through rheumatic heart disease in the promising years of childhood (table IV). In the two race groups combined there were 1,245 deaths of boys and 1,293 deaths of girls, altogether 2,538 deaths of persons under 20 years of age, from acute rheumatic fever; for diseases of the heart (all forms), which includes deaths from chronic rheumatic diseases, there were 6,127 deaths among boys and 5,910 among girls, altogether 12,037 deaths of persons under 20 years of age. If we add to this number the 2,538 deaths due to acute rheumatic fever, we get a total of 14,575 fatalities. If we take into consideration that in the age group under 5 most fatal heart diseases are not of rheumatic origin and, consequently, reduce the total by 1,776 (which is the difference between deaths from all heart diseases in this age, 2,088, and those listed as from chronic rheumatic heart diseases, 312), we have a total of 12,799 deaths in childhood. Considering that even in the ages above 5 years some deaths from heart diseases, probably less than 10 percent of the 9,949 deaths in these ages, may not be of rheumatic etiology and reducing our number accordingly, we still have approximately 12,000 deaths from this cause. This then is the minimum loss of life under 20 years of age due to rheumatic fever and its aftereffects, during the 3-year period 1939–41, in the United States.

The prevalence of rheumatic fever and rheumatic heart disease among children will, of course, be many times higher than the death rates. Fortunately, in only a relatively small proportion does the disease lead to immediate death or death within a year, the usual reporting period in vital statistics. But reliable estimates of the prevailing number of cases in the population are not obtainable as long as rheumatic fever is not a reportable disease and an accurate register for rheumatic diseases does not exist.[1] However, the available figures for the deaths show that the control of rheumatic fever presents one of the major public health problems affecting children.[2]

Age trends.—With increasing age, mortality from acute rheumatic fever and heart diseases (all forms) increases markedly during childhood. Among boys in the United States during 1939–41, average annual mortality due to these causes was 8.2 per 100,000 in the 5–9 year age group, 11.6 in the age group 10–14, and 14.8 in the age group 15–19 years. (See table III.) Correspondingly for girls, the rates for these causes jointly increase from 8.6 per 100,000 among 5–9 year-olds to 12.5 at 10–14 years of age and 13.9 for girls in the 15–19 year age group. This consistently upward trend in mortality for acute rheumatic fever and heart diseases (all forms) is found among white and nonwhite children and is a reflection of the un-

[1] See especially the chapter "The frequency of occurrence and general importance of rheumatic fever" by T. D. Dublin in The Epidemiology of Rheumatic Fever by John R. Paul (20); and Development of a Community Rheumatic Fever Program by Bernice G. Wedum in American Journal of Public Health, March 1946 (21).

[2] In a recent study by Selwyn D. Collins (22) a new attempt has been made to explore the incidence of rheumatic fever, based on the National Health Survey of 1935–36. Incidence, prevalence, and case fatality rates are shown in the surveyed population in connection with geographic variations and socio-economic characteristics. This comprehensive study on morbidity, which came to our knowledge only after the conclusion of this report, will form a most valuable complement to the present mortality investigation throughout the United States.

interrupted increase in the rate for heart diseases (all forms) in the ages from 5–19 years. As may be seen in table III, mortality from acute rheumatic fever alone, while increasing up to the age group 10–14, shows a decline in rate in the oldest age group, 15–19 years. On the other hand, mortality for diseases of the heart (all forms) for boys and girls in both racial groups increases continuously over the age group 5–19 years. This upward trend in mortality from heart diseases (all forms) may of course present in the successive age groups the aftereffects of acute rheumatic fever in the years preceding.

Race differences.—The race differential for total United States is demonstrated in table III by the ratios, nonwhite to white. These ratios, being above 1, show at a glance that in each age-sex group and for all three causes of death, the mortality rates of the nonwhite exceed somewhat those of the white children; the only exception being in the group of the 15–19 year-old males, and here only for chronic rheumatic heart diseases. This ratio, 0.9, indicates a slightly lower death rate in the nonwhite group than in the white. Altogether these differentials between color groups are not very striking; they are far less than in some other diseases (tuberculosis, syphilis, malaria). Nevertheless their consistent direction indicates a real significance and suggests that a more unfavorable social environment, which doubtless exists for the nonwhite group, tends to increase the risk of dying from rheumatic diseases. That is, rheumatic fever also belongs to that group of diseases in which, besides the specific etiological agent, the social environment, here correlated with race, plays an aggravating part.

The higher mortality from acute rheumatic fever, chronic rheumatic heart diseases and heart disease (all forms) among nonwhite as compared with white children prevails in almost all geographic divisions of the United States. This consistency between the finding for the entire country and its divisions greatly strengthens the inference that nonwhite children as a group experience higher risks of death from rheumatic diseases than other children. Ratios of the death rates, nonwhite to white, in the nine geographic divisions of the United States for each of the three causes of death mentioned, according to age-sex groups, are given for reference in Appendix A, with corresponding reference tables showing mortality rates and the size of population groups at risk (appendix tables 1, 2, 3, 4). The statistical significance of the race and sex differences in mortality from rheumatic heart disease is discussed below.

Sex differences.—Variations between boys and girls in mortality from rheumatic diseases are relatively small and not of statistical significance except in the age group 15–19 years. The sex ratios of the death rate, male to female, for acute rheumatic fever, chronic rheumatic heart disease, and heart disease (all forms), respectively, are also shown in table III for the United States as a whole. It will be seen from the ratios for the separate causes that there is no great consistency in sex differences for rheumatic fever fatalities, except perhaps in the nonwhite group which exhibits in most age groups a somewhat higher mortality for the females than for the males (ratios below 1). This is most distinct in the age group 15–19 years. Among the white children in this age group the males show higher rates than the females

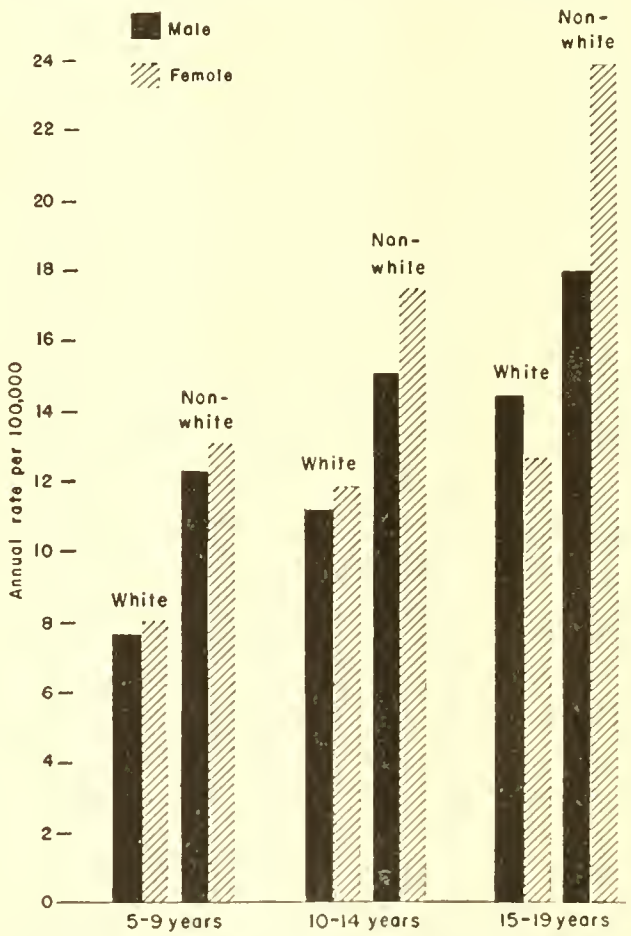

FIGURE I.—Death Rates for Acute Rheumatic Fever plus Diseases of the Heart in White and Nonwhite Children, by Age and Sex: United States, 1939–41.

(Average annual death rates per 100,000 in each specified group)

(ratios above 1). These age, race, and sex differences are shown graphically in Figure 1.

Within the several geographic divisions of the United States the differences between the sexes in respect to mortality from acute rheumatic fever and diseases of the heart (all forms) jointly are not great and are not in the same direction. (See next section.) The standard errors of the rates, shown for each geographic division in table V, make it clear that there is hardly any significant sex difference in mortality from rheumatic fever plus heart diseases on a regional basis. By simply adding or subtracting the respective errors almost all sex differences vanish when only one standard error is considered. Most sex differences for both racial groups in the different geographic divisions can thus be explained through mere chance fluctuation, with the exception of the highly significant differences in mortality of boys and girls in the age group 15–19 years.

The sex difference in mortality from acute rheumatic fever and heart diseases in this age group is of particular interest. The higher rates for boys (14.4) as compared with girls (12.6) in the white group, and lower rates for boys (17.9) than girls (23.8) in the nonwhite group, has just been mentioned for the country as a whole and is confirmed in the subdivisions. The consistency of these inverse findings in the two race groups is more important than the strict statistical significance reached in some regions. *In all nine geographical divisions the white boys have higher death rates than the girls; in all, except Mountain and Pacific, the nonwhite girls exhibit a distinctly higher mortality than the boys.* Why the young white females should show a more favorable mortality from rheumatic fever and heart diseases but the nonwhite females of the same age a more unfavorable mortality, when compared to the other sex, must be left to further clinical research. This statistical result is in contrast to the findings in the younger age groups where strictly signifi- sex differences were not observed in either race for mortality from acute rheumatic fever and heart diseases (all forms).

But it may be worthy of mention that for the United States as a whole, 1939–41, rates for these causes combined, as shown in table V, were perceptably, though not significantly, higher for girls than for boys in all age groups, with the sole exception of white children aged 15–19 where the rate for the boys (14.4) exceeds that for the girls (12.6). It appears that white boys of this age are under a greater strain than white girls. Whether this is due to physical labor, athletics, or other forms of recreation should be further investigated. On the other hand it appears that nonwhite girls are under a greater strain than nonwhite boys, in all likelihood due to the great risks in early childbearing. (For the rates and significance of the respective differences see the next section.)

Statistical Significance of Race and Sex Differences

Table V has been prepared to evaluate further the differences in mortality from rheumatic affections between white and nonwhite children. It shows, for each geographic division, the death rates and their standard errors in the two race groups, both sexes, and the age groups under examination. It also shows in each instance the difference, nonwhite minus white, and its standard error. To make the reading of the table more convenient a measure indicating the statistical significance of the differences is shown in the last two columns, for male and female. (This measure is the ratio of the difference to its standard error.) If the difference is three times its error (or more) the probability that the difference is due to chance alone is slight (expected by chance only 3 times out of 1,000 trials); if the difference is twice the standard error, the measure of significance is still high enough to make such a difference meaningful, especially if the deviations lie consistently in the same direction (only in 5 samples out of 100, or once in 20 is such a difference expected by pure chance). Thus we interpret all values of significance of 3 and above to indicate a difference very seldom due to chance, while those below 2 are indicative of nonsignificant chance fluctuations. Values between 2 and 3 are border cases approaching significance and may be discussed in connection with other findings. The signs of the respective differences (+ or —) show which of the two groups, white or nonwhite, has the higher mortality from rheumatic diseases.

In table V, following general suggestions by clinical advisors, we have combined the two causes, acute rheumatic fever (58) and all diseases of the heart (90–95) for the age groups from 5 through 19 years. (In the age group under 5 deaths from other diseases of the heart are more frequent

than from rheumatic origin; see table III.) In the age groups above 5 years, this combination gives a better account of all deaths due to rheumatic fever than the combination of acute rheumatic fever and chronic rheumatic diseases of the heart according to the official classification of the International List, as was pointed out earlier.

By considering the chance errors the geographic divisions can be compared more reasonably than by the usual procedure of comparing only death rates, since the computation of the corresponding standard errors takes into account the numbers of the exposed population whether large or small. Thus in some of the regions the differences between the two race groups may appear very high; for instance, in New England between the high death rate of the nonwhite boys and girls and the low rate of the white children. But here even the extreme differences in the age groups 10–14 and 15–19 years are not statistically significant (see table V) and in all four instances could have arisen by chance.

The following discussion of the differences in mortality between white and nonwhite children will consider each of the age groups in turn.

In the group, 5–9 years, the differences in mortality between white and nonwhite children are significant, amounting in the total United States to 4.6±.81 for the boys and 5.0±.83 for

Table V.—Death rates per 100,000 population with standard errors for acute rheumatic fever plus diseases of the heart (all forms) by age, race, and sex showing the difference between white and nonwhite: United States and geographical divisions, 1939–41

Area	White		Nonwhite		Differences: nonwhite—white (+ = nonwhite higher; − = white higher)		Significance of differences	
	Male	Female	Male	Female	Male	Female	Male	Female
	5–9 years							
United States	7.6±0.23	8.0±0.24	12.2± 0.78	13.0± 0.80	+ 4.6± 0.81	+ 5.0± 0.83	5.7	6.0
New England	5.2± .75	5.8± .81	14.7±10.40	14.8±10.48	+ 9.5±10.42	+ 9.0±10.51	.9	.9
Middle Atlantic	9.8± .59	10.8± .63	28.6± 4.31	25.6± 4.04	+18.8± 4.35	+14.8± 4.09	4.3	3.6
East North Central	8.7± .55	9.0± .57	17.2± 3.66	22.4± 4.16	+ 8.5± 3.70	+13.4± 4.20	2.3	3.2
West North Central	5.7± .60	6.9± .67	15.9± 5.62	19.4± 6.13	+10.2± 5.65	+12.5± 6.17	1.8	2.0
South Atlantic	7.1± .62	7.2± .64	11.2± 1.21	12.8± 1.28	+ 4.1± 1.36	+ 5.6± 1.43	3.0	3.9
East South Central	8.0± .81	6.6± .74	10.2± 1.50	10.5± 1.52	+ 2.2± 1.70	+ 3.9± 1.69	1.3	2.3
West South Central	5.8± .62	5.6± .62	8.3± 1.47	8.2± 1.45	+ 2.5± 1.59	+ 2.6± 1.58	1.6	1.6
Mountain	11.0±1.41	10.4±1.39	6.5± 4.60	6.3± 4.45	− 4.5± 4.81	− 4.1± 4.66	.9	.9
Pacific	4.5± .70	6.4± .85	13.1± 5.85	5.3± 3.74	+ 8.6± 5.90	− 1.1± 3.83	1.5	.3
	10–14 years							
United States	11.1±0.27	11.8±0.28	15.0± 0.85	17.4± 0.91	+ 3.9± 0.89	+ 5.6± 0.95	4.4	5.9
New England	11.3±1.03	9.9± .98	26.8±13.40	19.6±11.31	+15.5±13.44	+ 9.7±11.35	1.2	.9
Middle Atlantic	15.2± .68	16.6± .72	29.6± 4.22	35.4± 4.53	+14.4± 4.28	+18.8± 4.59	3.4	4.1
East North Central	11.4± .59	13.4± .65	18.1± 3.62	32.2± 4.75	+ 6.7± 3.67	+18.8± 4.79	1.8	3.9
West North Central	10.3± .77	9.5± .75	15.2± 5.38	13.3± 5.02	+ 4.9± 5.43	+ 3.8± 5.08	.9	.7
South Atlantic	8.6± .66	8.9± .69	15.5± 1.41	17.1± 1.47	+ 6.9± 1.56	+ 8.2± 1.62	4.4	5.1
East South Central	10.0± .88	8.8± .84	9.6± 1.45	11.6± 1.59	− .4± 1.70	+ 2.8± 1.80	.2	1.6
West South Central	7.3± .68	8.1± .72	13.7± 1.87	12.9± 1.80	+ 6.4± 1.98	+ 4.8± 1.94	3.2	2.5
Mountain	16.5±1.70	17.9±1.80	14.2± 7.09	14.4± 7.19	− 2.3± 7.29	− 3.5± 7.42	.3	.5
Pacific	7.6± .87	7.8± .90	8.5± 4.25	13.4± 5.47	+ .9± 4.34	+ 5.6± 5.55	.2	1.0
	15–19 years							
United States	14.4±0.29	12.6±0.28	17.9± 0.95	23.8± 1.06	+3.5± 0.99	+11.2± 1.10	3.5	10.2
New England	15.1±1.15	12.7±1.06	26.1±13.06	44.2±16.70	+11.0±13.11	+31.5±16.73	.8	1.9
Middle Atlantic	20.2± .75	18.7± .73	27.2± 4.19	35.8± 4.58	+ 7.0± 4.26	+17.1± 4.64	1.6	3.7
East North Central	14.4± .65	13.6± .63	24.2± 4.28	29.4± 4.54	+ 9.8± 4.33	+15.8± 4.58	2.3	3.4
West North Central	11.6± .79	9.7± .73	6.0± 3.45	26.4± 7.05	− 5.6± 3.54	+16.7± 7.09	1.6	2.4
South Atlantic	11.1± .74	10.0± .71	17.4± 1.51	24.2± 1.73	+ 6.3± 1.68	+14.2± 1.87	3.8	7.6
East South Central	11.9± .97	9.2± .86	15.7± 1.93	21.6± 2.19	+ 3.8± 2.16	+12.4± 2.36	1.8	5.3
West South Central	11.2± .84	8.7± .74	14.2± 1.95	18.6± 2.16	+ 3.0± 2.12	+ 9.9± 2.29	1.4	4.3
Mountain	20.1±1.87	16.1±1.69	38.6±12.20	8.0± 5.65	+18.5±12.34	− 8.1± 5.89	1.5	1.4
Pacific	10.0± .94	7.4± .82	22.2± 6.15	21.1± 6.36	+12.2± 6.22	+13.7± 6.42	2.0	2.1

the girls, in both instances six times their standard errors. Highly significant also are the differences in the Middle Atlantic where nonwhite children incur the highest death rates found in any division. Significance is also reached or approached in the similarly industrial division, East North Central (Ohio, Indiana, Illinois, Michigan, Wisconsin). The high differences (10.2 ± 5.65 and 12.5 ± 6.17) in the West North Central division are probably not significant because of the small nonwhite population in these seven States (Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas), half of which live in the one State of Missouri. In contrast to this finding are the much smaller yet statistically significant racial differences in the South Atlantic division (4.1 ± 1.36 and 5.6 ± 1.43). In the other divisions the race differences are hardly significant; yet it is characteristic in this age group, that in almost all parts of the nation, nonwhite children show higher death rates than white children (+sign). There is only one noteworthy exception to this; white children in the Mountain States show a higher mortality rate than do nonwhite children. Although this unusual difference is not at all significant in a statistical sense, it may have some real meaning since white children in the other age groups also have a higher rate than the nonwhite children in the Mountain division.

It must be remembered that in these States, especially in Arizona, New Mexico, and Colorado, the Spanish-speaking Americans of Mexican origin represent a relatively large proportion of the total population. In the 1940 census they were counted as white and this may have been a factor in raising mortality rates for rheumatic heart diseases in the white group and reducing the rate for the remaining nonwhite population. Indeed, if we consider the rates for the nine geographic divisions, it is seen that in all age groups, from 5–9 up, the Mountain division has the highest death rates for the whites (approached or surpassed, in some instances only by the Middle Atlantic States) whereas the nonwhite rates are extremely low (especially when compared with the likewise high death rates of the nonwhite group in the Middle Atlantic). This striking difference between the relation of the death rates for white and nonwhite children in the Mountain States and the relation existing in other regions suggests that there are basic differences in population classification not controlled in the statistics now available. The fact of this high mortality for white children in the Mountain States has been observed by a number of investigators (4, 23, 24, 25). One cannot very well suppose that a common etiological factor, for instance climate, would be unfavorable to the white but favorable to the nonwhite group in the same locality. Of course the population factor offers only one of the possible explanations and there may be other factors that make for the high mortality from rhematic heart diseases in the white population of the Mountain States.

In the following age group, 10–14 years, mortality from acute rheumatic fever plus heart disease is higher than in the preceding age group. The respective death rates of the white boys and girls in the total United States have gone up from $7.6 \pm .23$ and $8.0 \pm .24$, in the 5–9 year-old children, to $11.1 \pm .27$ and $11.8 \pm .28$; the corresponding death rates of the nonwhite rose from $12.2 \pm .78$ and $13.0 \pm .80$ to $15.0 \pm .85$ and $17.4 \pm .91$.

The race differences for the country as a whole in this age group ($3.9 \pm .89$ and $5.6 \pm .95$) show the higher mortality of nonwhite children, the values of significance being 4.4 and 5.9. Although the much higher differences between white and nonwhite in New England are not significant, the high differences in the Middle Atlantic and, for the girls, in the East North Central divisions are beyond chance fluctuation. Even more marked are the racial differences in the large group of the South Atlantic, the values being 6.9 ± 1.56 and 8.2 ± 1.62 for boys and girls, respectively. Significance is also reached in the West South Central division (Arkansas, Louisiana, Oklahoma, Texas). In all others the differences are small and insignificant. But attention must again be paid to the direction of the differences. Table V shows a higher mortality for nonwhites than whites in all regions except the Mountain division (the small negative differences of 0.4 for the boys in East South Central is negligible). The Mountain States also show the highest death rates among all divisions for white boys and girls (even higher than in the Middle Atlantic group).

In the adolescent group, 15–19 years, the mortality rates for acute rheumatic fever plus heart diseases are again higher than in the preceding age group, due to appreciably higher rates for mortality from heart diseases (all forms) in both racial groups, as previously explained.

The finer comparisons of differential mortality in this age resemble those described before, though with some remarkable distinctions. For the

country as a whole the race differences are statistically significant for both sexes, but the much greater difference between white and nonwhite girls, 11.2±1.10 (10 times its standard error) is noteworthy in view of the fact that for the boys the difference is only 3.5±1.0. These different results for girls and for boys are due to high death rates for the nonwhite females and the relatively high death rates for white males. For nonwhite females the rate for the total United States amounts to 23.8±1.06 and is, in this age group only, significantly higher than the rate of the nonwhite males 17.9±.95. This difference in rates for nonwhite girls and boys, 5.9±1.42, is more than four times its error. For the white adolescents it is just the other way around. The white boys have a significantly higher death rate, 14.4±.29, in this age group alone than the white girls, 12.6±.28; the difference of 1.8±.40 being also more than four times its error. The reversal in relative position of white boys and girls in this age group in respect to mortality from rheumatic fever and heart diseases, and the exceptionally high rate for nonwhite girls result in the small racial difference found for boys as compared with the very large racial difference for girls in this age group.

The large differences in mortality between white and nonwhite females in the age group 15–19 are seen in most of the geographic divisions, though they are not always beyond possible chance fluctuations, not even the high difference between white and nonwhite girls in New England (31.5±16.7). The higher mortality of the nonwhite girls is beyond reasonable limits of chance in the Middle Atlantic and East and West North Central and is most significant in the South Atlantic and East and West South Central divisions.

The boys show a strictly significant racial difference only in the South Atlantic States, but the tendency to a higher mortality for the nonwhite is indicated in all divisions (+ sign) except in West North Central. It can be stated again that the higher mortality of the nonwhite group from rheumatic heart diseases is clearly demonstrated in this age, in agreement with the findings of such former investigators as Atwater (23), Dauer (24), Dublin and Lotka (26).

Thus the results in the geographic divisions confirm in greater detail with few exceptions what has been stated before for the United States as a whole. An explanation of the prevailing higher mortality among nonwhite children may be that the nonwhite children do not get the same amount of medical care as do white children and, therefore, die more often of the disease, or that unfavorable social-environmental conditions, especially bad housing, lack of hospitalization, lack of education and hygiene, etc., contribute to spread the acute disease, to increase rheumatic complications and, consequently, to increase the death rates per population unit. In the case of girls in the age group 15–19 years, it may be that different fertility in the two racial groups has a bearing on the eventual outcome of heart disease, as is the case, for instance, in tuberculosis mortality. The claim is sometimes made that there is a greater constitutional susceptibility among the nonwhite than among whites. Assuming that the groupings white and nonwhite provide an approximate race classification, there is still no proof of a race disposition to rheumatic diseases. There do exist familial dispositions within each race group to rheumatic diseases, as well as to other chronic infectious diseases.[3] But the possibility of a greater spread of rheumatic diseases among specific race groups cannot be explored with presently available vital statistics. The most likely explanation of the higher mortality rates among nonwhite children is that rheumatic fever diseases more often take a fatal course because of insufficient medical care; that is, that the nonwhite have a higher case fatality rate.

[3] See literature on familial epidemiology of rheumatic fever in Wilson (27) and Paul (28), of tuberculosis in Wolff and Ciocco (29), Puffer (30).

V. Regional Differences in Childhood Mortality From Acute Rheumatic Fever and Diseases of the Heart

The differences between the geographic divisions of the United States in regard to mortality from rheumatic heart diseases are of considerable interest from the viewpoint of national health. These variations have been considered in several earlier epidemiological studies (4, 24, 28). In the present investigation regional variations are delineated through a comparison of mortality in each of the geographic divisions with rates for the United States as a whole.

The comparison of mortality rates in different geographic regions can be simplified and summarized by combining the three age groups (5–9, 10–14, and 15–19 years) and the two sex groups, while taking account of those differences in regional rates which are a reflection of varying proportions of white and nonwhite children. The latter adjustment for the relative weight of race groups in the different regions is necessary in rates for all children (white and nonwhite combined), because the proportions of white and nonwhite children differ greatly from region to region. Without such adjustment, regional differences associated with climatic-geographic and related factors would be confounded with those explainable on the basis of a varying composition of the population in different regions (38, 39).

In table VI such adjusted regional rates are shown for mortality from acute rheumatic fever and diseases of the heart among all children, together with crude (unadjusted) rates and with rates for white and for nonwhite groups separately. Adjustment for a constant racial composition throughout the geographic divisions has been made on the basis of the distribution of white and nonwhite children 5 to 19 years of age, in the total United States, 1940. The adjustment factors (0.88153 for the white and 0.11847 for the nonwhite children) have been applied to the race-specific death rates of the different divisions to obtain the adjusted rates. Adjustment for regional differences in age and sex in childhood has not been deemed worthwhile since the proportions of the sexes and the age groups within the limits from 5 to 19 years do not vary markedly among regions.

Table VI.—Mortality from acute rheumatic fever plus diseases of the heart in children, 5 through 19 years of age, by race: United States and Geographic Divisions, 1939–41

AVERAOE ANNUAL RATES PER 100,000

Geographic divisions (Ranked according to crude rates)	Crude rate (all races)	Geographic divisions (Ranked according to adjusted rates)	Adjusted rate [1] (all races)
United States	11. 7	United States	11. 7
1. Pacific	7. 7	1. Pacific	8. 3
2. West South Central	8. 8	2. West South Central	8. 4
3. West North Central	9. 3	3. East South Central	9. 6
4. East South Central	10. 2	4. South Atlantic	9. 8
5. New England	10. 5	5. West North Central	9. 9
6. South Atlantic	11. 1	6. New England	12. 0
7. East North Central	12. 4	7. East North Central	13. 3
8. Mountain	15. 3	8. Mountain	15. 3
9. Middle Atlantic	16. 3	9. Middle Atlantic	17. 4

(Ranked according to rates for white children)	White	(Ranked according to rates for nonwhite children)	Nonwhite
United States	11. 1	United States	16. 6
1. Pacific	7. 4	1. West South Central	12. 7
2. West South Central	7. 8	2. East South Central	13. 1
3. South Atlantic	8. 9	3. Mountain	14. 2
4. East South Central	9. 1	4. Pacific	14. 7
5. West North Central	9. 1	5. West North Central	16. 1
6. New England	10. 3	6. South Atlantic	16. 4
7. East North Central	11. 9	7. East North Central	24. 1
8. Mountain	15. 4	8. New England	24. 9
9. Middle Atlantic	15. 6	9. Middle Atlantic	30. 5

[1] Adjusted for constant proportions of white and nonwhite children in the different geographic divisions (for adjustment factors see text).

Adjusted regional mortality rates for acute rheumatic fever and diseases of the heart, among all children 5–19 years of age, range from 8.3 per 100,000 in the Pacific, and 8.4 in the West South Central divisions to 17.4 in the Middle Atlantic group of States. Pacific and all three southern divisions show lower mortality rates than those for northern, Mountain, and Middle Atlantic divisions. Ranked for the adjusted rates, the divisions follow in this order: 1. Pacific (8.3); 2. West South Central (8.4); 3. East South Central (9.6); 4. South Atlantic (9.8); 5. West North Central (9.9); 6. New England (12.0); 7. East North Central (13.3); 8. Mountain (15.3); and 9. Middle Atlantic (17.4). (The rank order is not as consistent for the crude rates; see table.) With minor deviations this rank order prevails for regional rates for white children considered independently although in each division except Mountain the rates are lower than the adjusted regional rates for all children (white and nonwhite combined). Lower regional rates in southern and Pacific divisions as compared with northern and Middle Atlantic divisions are also characteristic of the nonwhite children; but the rate in the Mountain division (14.2) ranks third, in the neighborhood of relatively low rates for the nonwhite group in the southern and Pacific divisions (1. West South Central, 12.7; 2. East South Central, 13.1; 4. Pacific, 14.7), rather than adjacent to the highest regional rate (Middle Atlantic 30.5) as among white children.

The rank order of the Mountain division is doubtful because the adjustment based on population composition in terms of "white" and "nonwhite" is less successful in this division than in the others. In the other divisions, the groupings "white" and "nonwhite" correspond roughly to major groupings according to socio-economic status, so that adjustment for race tends to equalize such factors also. In the Mountain division, on the other hand, the "white" and "nonwhite" groups do not give as clear a differentiation from a socio-economic point of view. Children of Mexican origin who represent a relatively underprivileged portion of the population are included in the "white" group and they are found in somewhat larger proportion in the population of the Mountain than of the other divisions.

Notwithstanding these limitations on statistical control of socio-economic differences, the progression of relatively low rates in southern and Pacific divisions to significantly high rates in the northern and Middle Atlantic divisions points to the role of certain climatic-geographic factors of the natural environment in mortality from rheumatic diseases in childhood (31).

This becomes more evident in the adjusted rates where the race variable is kept constant than in the crude rates of a varying race composition. For race is not independent of social-environmental factors. We quote in this respect from the Census Bureau publication on Vital Statistics Rates in the United States, 1900–1940: "When deaths are classified by race, there is created also, for example, a hidden classification of economic status to the extent that economic status is correlated with race. An observed difference in mortality between races may in actuality be no more than a difference of mortality for different economic classes".[4] Further studies will be needed to consider how much of what appears to be climatic-geographic difference in mortality may be attributed to differences in degree and character of urbanization.

[4] Linder and Grove (32). See especially section: Classification of Age, Race, and Sex, pp. 9–12.

Statistical Significance of Geographic Differences

The regional differences broadly indicated in table VI for mortality from acute rheumatic fever and heart disease (all forms) on the basis of children across the age range 5–19 years are substantiated by closely similar regional differences, prevailing in most cases for boys and girls alike, in each of the age groups, 5–9, 10–14, and 15–19 years. Table VII has been prepared to permit a detailed consideration of the significance of geographic variations in mortality rates within each of the age-sex-race groupings. This table shows for each of these groupings, the difference between the mortality rate for the total United States and the rate for each geographic division. The standard error of each division and its statistical significance is also given. The mortality rates

Table VII.—Differences with standard errors[1] between total United States and each geographic division for mortality, by age race, and sex, from acute rheumatic fever plus diseases of the heart (all forms), 1939–41

Division	White				Nonwhite			
	Difference: United States—specified division		Significance of difference		Difference: United States—specified division		Significance of difference	
	Male	Female	Male	Female	Male	Female	Male	Female
	5–9 years							
New England	+2.4±0.87	+2.2±0.91	2.8	2.4	−2.5±9.48	−1.8±9.82	0.3	0.2
Middle Atlantic	−2.2± .46	−2.8± .49	4.8	5.7	−16.4±2.72	−12.6±2.78	6.0	4.5
East North Central	−1.1± .46	−1.0± .48	2.4	2.1	−5.0±3.00	−9.4±3.08	1.7	3.1
West North Central	+1.9± .65	+1.1± .67	2.9	1.6	−3.7±4.88	−6.4±4.97	.8	1.3
South Atlantic	+ .5± .60	+ .8± .63	.8	1.3	+1.0±1.00	+ .2±1.02	1.0	.2
East South Central	− .4± .75	+1.4± .78	.5	1.8	+2.0±1.45	+2.5±1.49	1.4	1.7
West South Central	+1.8± .67	+2.4± .70	2.7	3.4	+3.9±1.61	+4.8±1.65	2.4	2.9
Mountain	−3.4±1.14	−2.4±1.19	3.0	2.0	+5.7±6.28	+6.7±6.36	.9	1.1
Pacific	+3.1± .88	+1.6± .91	3.5	1.8	− .9±5.62	+7.7±5.82	.2	1.3
	χ^2=66.0 P=<.00000	58.7 <.00000			44.9 <.00000	41.3 <.00000		
	10–14 years							
New England	−0.2±1.01	+1.9±1.04	0.2	1.8	−11.8±10.00	− 2.2±10.61	1.2	0.2
Middle Atlantic	−4.1± .52	−4.8± .54	7.9	8.9	−14.6± 2.89	−18.0± 3.04	5.1	5.9
East North Central	− .3± .53	−1.6± .55	.6	2.9	− 3.1± 3.19	−14.8± 3.37	1.0	4.4
West North Central	+ .8± .77	+2.3± .80	1.0	2.9	− .2± 5.67	+ 4.1± 5.67	.0	.7
South Atlantic	+2.5± .72	+2.9± .74	3.5	3.9	− .5± 1.09	+ .3± 1.17	.5	.3
East South Central	+1.1± .91	+3.0± .94	1.2	3.2	+ 5.4± 1.60	+ 5.8± 1.73	3.4	3.4
West South Central	+3.8± .80	+3.7± .83	4.8	4.5	+ 1.3± 1.76	+ 4.5± 1.89	.7	2.4
Mountain	−5.4±1.40	−6.1±1.45	3.9	4.2	+ .8± 7.25	+ 3.0± 7.85	.1	.4
Pacific	+3.5±1.04	+4.0±1.07	3.4	3.7	+ 6.5± 5.58	+ 4.0± 6.17	1.2	.6
	χ^2=110.6 P=<.00000	152.5 <.00000			36.6 <.00009	64.8 <.00000		
	15–19 years							
New England	−0.7±1.07	−0.1±1.03	0.7	0.1	− 8.2±10.80	−20.4±12.20	0.8	1.7
Middle Atlantic	−5.8± .55	−6.1± .53	10.5	11.5	− 9.3± 3.27	−12.0± 3.58	2.8	3.4
East North Central	0 ± .57	−1.0± .55	0	1.8	− 6.3± 3.56	− 5.6± 3.94	1.8	1.4
West North Central	+2.8± .82	+2.9± .79	3.4	3.7	+11.9± 5.90	− 2.6± 6.60	2.0	.4
South Atlantic	+3.3± .78	+2.6± .75	4.2	3.5	+ .5± 1.21	− .4± 1.34	.4	.3
East South Central	+2.5±1.01	+3.4± .98	2.5	3.5	+ 2.2± 1.84	+ 2.2± 2.04	1.2	1.1
West South Central	+3.2± .88	+3.9± .85	3.6	4.6	+ 3.7± 1.98	+ 5.2± 2.21	1.9	2.4
Mountain	−5.7±1.53	−3.5±1.48	3.7	2.4	−20.7± 8.27	+15.8± 9.68	2.5	1.6
Pacific	+4.4±1.07	+5.2±1.04	4.1	5.0	− 4.3± 5.45	+ 2.7± 6.67	.8	.4
	χ^2=154.9 P=<.00000	188.6 <.00000			26.0 <.00105	23.2 <.00315		

[1] Standard error of the difference for a subsample drawn from a sample (compare footnote 5).

NOTE: + sign of the difference means a higher death rate in total United States; − sign a higher death rate in the division (the death rates themselves and their errors are given in table V).

for the United States and each division, from which the differences in table VII are derived are given in table V. We will discuss the geographical differences again for each of the age groups in turn.[5]

[5] In order to test the geographic differences it seems reasonable to compare the different divisions with the average mortality in the country as a whole. Here, we then have (instead of two mutually exclusive groups in each division) nine groups (divisions) or variants of mortality to be compared with the rate in the total United States. The latter represents the weighted average of all subdivisions.

Since in each case a differing subsample (the respective division) is drawn from the same universe (total United States), the errors of the two death rates are not independent, but correlated with each other to various degrees. Therefore, the standard error of the difference cannot be computed by the usually accepted formula for independent samples $\epsilon_{diff}=\sqrt{E_1^2+E_2^2}$. To test the differences between the total United States and single divisions (or other subgroups) a formula Yule (33) has worked out, considering the correlation between errors in the subsample and the entire sample, has been applied.

This formula for the standard error (E) of the difference between sample and subsample reads:

$$E_{diff}=\sqrt{\frac{pq}{n_1+n_2}\cdot\frac{n^2}{n_1}}=\sqrt{\frac{pq}{N}\cdot\frac{N-n}{n}}=\sigma N\sqrt{\frac{N-n}{n}};$$

$$n_1+n_2=N.$$

Therefore,

$$\sqrt{\frac{pq}{n_1+n_2}}=\sigma N.$$

where N denotes the number of the entire sample, n the number of the respective subsample.

Only the differences of the death rates (total United States minus the specified division), marked plus or minus, are shown in the table with their standard errors. These geographical differences cannot, of course, lie in one direction only (+ meaning a higher death rate in the whole country than in the subdivision; — meaning a higher death rate in the specified division). On the contrary, the plus and minus deviations from the average must necessarily balance if their statistical weights, i. e. the population numbers of the respective divisions, are taken into consideration. However, the distribution of lower or higher death rates among the geographic divisions furnishes some valuable information even though the differences are not always significant. To make the table more understandable the significance is again shown in each instance.

Values of χ^2 and P for eight degrees of freedom ($n=9-1$) are further shown in the same table and will be discussed separately. The expected deaths (absolute numbers) for this complementary test (goodness-of-fit) are computed on the assumption that the children in the different regions would have died at the same rate as in the total United States. The details of the computation, the actual and expected numbers of the deaths by age, race, and sex, are not shown but can easily be obtained from the material available in the tables. However, it must be kept in mind that by the additive character of the χ^2 test all deviations of the nine divisions, the positive as well as the negative, are summed up in one value to indicate the probability of just such a divergency of factual from theoretical distribution. Because of this summarizing effect of the χ^2 test, the individual comparison between the total United States and each specified division, as presented in table VII, is of greater practical meaning, showing the under-average and over-average mortality in each geographic division and its individual significance.

In the age group 5–9 years, the variations among divisions in mortality due to acute rheumatic fever plus heart diseases are rather distinct for both races and sexes. In fact, in the white group most of the differences between the divisions and the total United States are statistically significant. The highest death rates for the white boys are reported in the Mountain division with 11.0 ± 1.41, and for the white girls in the Middle Atlantic division with $10.8\pm.63$; the lowest rates for white boys occurs in the Pacific division with $4.5\pm.70$, and for white girls in the West South Central division with $5.6\pm.62$. (See table V.)

There are only a few instances (South Atlantic and East South Central) where the death rates do not differ essentially from the average rates. The mortality from rheumatic heart diseases is consistently higher (minus differences) in the Middle Atlantic and East North Central, while the rates are appreciably lower (plus differences) in southern regions and the Pacific coast. This is in close agreement with the findings of former epidemiological studies. A striking exception for the white group is found in the North in New England (with definitely lower rates than in the country as a whole) and in the West in the Mountain division (with definitely higher mortality rates). Why the white children in New England show exceptionably low rates in this age cannot be easily explained; the socio-economic factors adversely affecting the Spanish-speaking population of Mexican origin offers a possible explanation for the extremely high rates for the white groups in the Mountain States, as was mentioned before.

The contrast between rheumatic fever mortality in the North and in the South is even more marked in the nonwhite group of this age. In all divisions of the North the death rates are higher than in the total United States for the nonwhite group, though not always significantly so. The negative deviations in the Middle Atlantic are especially high. In all divisions of the South, in the Mountain States, and in the Pacific

(for girls only) mortality from rheumatic heart diseases in the nonwhite group is more favorable than rates for this group in the country as a whole, even though the difference is usually not significant. Consequently the χ^2 values are so high, in both racial groups and both sexes, that the summed deviations of the observed from the expected deaths cannot be attributed to chance.

In the following age group, 10–14 years, the difference in rheumatic fever mortality between the northeastern divisions and the southern and West Coast divisions is even greater. In the white group, the New England boys and the Middle Atlantic, East North Central, and Mountain children of both sexes show death rates more or less above those for the country as a whole; West North Central, all three southern divisions, and the Pacific have, as a rule, significantly lower death rates. The highest rates occur again in the Mountain States with 16.5 ± 1.70 for the white boys and 17.9 ± 1.80 for the white girls, followed closely by the Middle Atlantic States with $15.2 \pm .68$ and $16.6 \pm .72$, for the boys and girls respectively; the lowest rates are seen in West South Central, $7.3 \pm .68$ and $8.1 \pm .72$, and in the Pacific division, $7.6 \pm .87$ and $7.8 \pm .90$, for boys and girls respectively. (See table V.) The differences between these extremes, if they are treated as independent samples of the parent universe, are highly significant whereas, for instance, the smaller differences between the three southern divisions are not.

In the nonwhite group of the same age, the geographic contrasts in mortality from rheumatic heart diseases are more consistent, although not of the same statistical significance. In New England, Middle Atlantic, and East North Central the rates for nonwhite boys and girls are appreciably higher than the corresponding rates for these groups in the country as a whole; in East South Central, West South Central, and the Pacific they are appreciably lower; while in West North Central, South Atlantic and Mountain the deviations from the average are negligible. Altogether, the two racial groups behave somewhat similarly (with the exception of the Mountain States which again show high rates for the white and comparatively low rates for the nonwhite children). The single values of significance are usually higher in the white group. Therefore, the χ^2 values also are much greater for the white boys and girls, 110.6 and 152.5, than for the nonwhite, 36.6 and 64.8; yet all four values indicate that the actual mortality rates in the nine divisions, or their deviations from the average mortality of the country, cannot be explained by chance fluctuations alone.

In the last age group, 15–19 years, the results are very similar to those in the preceding, though not so consistent in the nonwhite group. However, it is obvious that the mortality is higher for both racial groups in most northeastern parts of the country, especially in the Middle Atlantic division, and for the whites in the Mountain division (negative differences). In West North Central, the three divisions of the South, and the Pacific, the rates are generally lower than in the country as a whole (positive differences). In accordance with the great significance of the differences in most geographic division, in this age group the value of χ^2 are again extremely high for the white group, 154.9 and 188.6 for boys and girls respectively, while the much lesser values for the nonwhite group, 26.0 and 23.2, leave open a certain probability of chance fluctuations. It will be seen from table VII that among the individual differences in the nonwhite group significance is approached or reached only in the high mortality rates of the Middle Atlantic division, the negative deviations from the average being 9.3 ± 3.27 and 12.0 ± 3.58 for boys and girls respectively.

In summarizing, it may be said that this analysis of geographic differences within age-sex-race groups confirms the findings based on all children, 5–19 years. There are certain geographic variations in mortality from rheumatic fever and rheumatic heart afflictions which cannot be attributed to chance. In general, the death rates in the South are below average, and in the Northeast, especially in the Middle Atlantic division, they are above. In the Pacific coast region they are as low as in the South; while the Mountain States, for the white children, occupy an exceptional position with extremely high rates.

VI. Rank Order of Individual States in Mortality From Acute Rheumatic Fever and Diseases of the Heart

The analysis of differential mortality by regions can be sharpened by reducing the geographic unit from a regional to a State basis. This has the further advantage of relating the discussion to political jurisdictions which have responsibility for the administration of public-health and medical-care programs for children with physical disabilities and disabling illness. The details in regard to age, sex, and race will be exhibited later in Appendix B together with the State tables arranged in the same way as for the geographic divisions. They show age-race-sex specific death rates, the number of the deaths, and the population at risk for each group in the individual States.

To make a short review of State-to-State comparisons possible and to provide at the same time a rank order of the States in childhood mortality from rheumatic heart diseases, the following table VIII is presented, combining the three age groups, 5–9, 10–14, and 15–19 years, the two race groups, and the two sexes. Death rates and deaths are shown again in the 3-year period, 1939–41, for acute rheumatic fever plus diseases of the heart for all races (total crude rate) as well as for the white and nonwhite children separately, 5 through 19 years of age. It is obvious that the combined rates, and still more the number of deaths, are of practical value for the public health officer in planning programs for control of rheumatic fever, independent of age, race, or sex differentials.

The States are ranked according to the crude rates for all children; the rank order of the rates for white and nonwhite children is shown in brackets. The rank order for all children and the white children in the 49 States (including the District of Columbia) will necessarily differ because the proportions of white and nonwhite children differ greatly from State to State (from less than 1 to more than 50 percent). That this must be the case is clear if one considers the preceding results which have evidenced that the nonwhite group develops markedly higher death rates for rheumatic fever diseases than the white. It should be mentioned also that the rank numbers of the States for nonwhite children are not comparable with those for white children because they refer to only 27 States in which rates for nonwhite children are shown as based on large enough numbers; however, the latter numbers indicate the rank order within these States for the nonwhite group (see footnotes on table VIII).

The range of the crude rates about the average for the United States, 11.7 per 100,000 for mortality from acute rheumatic fever plus heart diseases, was somewhat greater than four-fold, from 5.3 in Vermont to 22.4 in Utah. The median position in mortality from rheumatic heart diseases was occupied by Connecticut with a rate of 10.6. The following States showed, during the 3-year period, 1939–41, rates in the lowest quartile: Vermont, 5.3; California, 6.6; Arkansas, 6.7; Maine, 7.5; Kansas, 7.7; Florida, 8.1; Mississippi, 8.1; Arizona, 8.3; Nebraska, 8.9; Texas, 9.0; Oklahoma, 9.0; and Washington 9.2. States ranking in the quartile with highest mortality for rheumatic heart diseases were: Indiana, 13.4; Illinois, 13.5; Idaho, 13.6; Nevada, 13.8; Montana, 14.8; New York, 16.0; Pennsylvania, 16.4; New Jersey, 17.1; District of Columbia, 17.8; Colorado, 18.7; Delaware, 19.2; and Utah, 22.4.

The wide range of differences in mortality due to rheumatic fever and heart diseases among the States illustrates that much can be done to lower and equalize the risks to children of dying from these causes in the different States. In general, these results for the States confirm those obtained for the divisions, namely, that the death rates are lower in the South than in the Northeast, especially the Middle Atlantic States, lower in the Pacific than in the Mountain States. This tendency becomes still more distinct if we consider separately the rates for the white and nonwhite children, thus dealing with a more homogeneous group in the statistical sense.

It will be seen from the table that the range of the death rates for the white children was similar to the range of the crude rates (from 5.3 per 100,000 in Vermont to 22.0 in Utah, the average rate for the United States being 11.1). However, the rank order changes appreciably as the bracketed rank numbers show. Most rates for the white children are lower than the total crude rates and the rates for the nonwhite children wherever the latter are shown. Therefore, most southern States, in which the bulk of the nonwhite children live, obtain for the white children a more favorable rank than shown by the crude rates for both races combined; this is noteworthy especially in Florida,

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Mississippi, Louisiana, Georgia, Alabama, North and South Carolina, in which the differential between white and nonwhite rates is high (see table). This high differential is obvious also in the Northeast, especially in the Middle Atlantic States; but the weight of the nonwhite population in these States is relatively small and, therefore, does not influence so much the total crude rate. (For a graphic presentation of these mortality rates, see Figure 2, pp. 34–35.)

Certainly, there are always some minor exceptions which cannot be pressed into the rigid scheme of a rank order, the much more so since the individual States have quite different weights in population size. Thus the State of Vermont in the Northeast has a very low rate for mortality

Table VIII.—Death rates and deaths from acute rheumatic fever plus diseases of the heart in children, 5 through 19 years of age, by race:[1]

UNITED STATES AND EACH STATE, 1939–41

States ranked according to crude rates (Rank order of white and nonwhite in brackets)[2]	Average annual rate per 100,000			Number of deaths in 3 years		
	Total crude	White	Nonwhite	Total	White	Nonwhite
United States	11.7	11.1	16.6	12,236	10,185	2,051
1. Vermont	5.3	5.3 (1)	(1)	15	15	----
2. California	6.6	6.3 (5)	12.0 (5)	290	262	28
3. Arkansas	6.7	6.0 (2)	8.8 (1)	123	83	40
4. Maine	7.5	7.6 (9)	(1)	52	52	----
5. Kansas	7.7	7.4 (8)	17.7 (15)	109	100	9
6. Florida	8.1	6.2 (3)	12.8 (7)	120	65	55
7. Mississippi	8.1	6.3 (4)	9.8 (4)	172	65	107
8. Arizona	8.3	8.0 (10)	9.6 (2)	37	30	7
9. Nebraska	8.9	8.9 (16)	(1)	94	93	1
10. Texas	9.0	8.3 (12)	12.8 (6)	502	394	108
11. Oklahoma	9.0	9.0 (17)	9.7 (3)	191	169	22
12. Washington	9.2	8.5 (14)	(1)	108	97	11
13. Rhode Island	9.3	8.9 (15)	(1)	50	47	3
14. North Dakota	9.4	9.1 (20)	(1)	55	52	3
15. Missouri	9.5	9.0 (18)	17.2 (14)	268	238	30
16. New Hampshire	9.5	9.5 (24)	(1)	35	35	----
17. Minnesota	9.6	9.4 (23)	(1)	206	201	5
18. Iowa	9.7	9.7 (25)	(1)	189	187	2
19. West Virginia	9.8	9.3 (22)	18.2 (16)	177	158	19
20. Louisiana	9.9	6.4 (6)	15.7 (11)	211	85	126
21. South Dakota	9.9	10.4 (29)	(1)	55	55	----
22. Georgia	10.1	7.3 (7)	15.0 (10)	296	134	162
23. Virginia	10.4	9.0 (19)	14.2 (9)	252	159	93
24. Alabama	10.4	8.5 (13)	13.9 (8)	288	149	139
25. Connecticut	10.6	9.9 (26)	(1)	130	119	11
26. Kentucky	10.7	10.0 (28)	20.7 (19)	281	246	35
27. Michigan	10.9	10.5 (30)	23.1 (21)	447	410	37
28. Tennessee	11.1	10.0 (27)	16.8 (13)	291	218	73
29. Wisconsin	11.1	11.1 (32)	(1)	272	268	4
30. North Carolina	11.2	9.2 (21)	15.7 (12)	399	229	170
31. Wyoming	11.8	11.0 (31)	(1)	24	22	2
32. Oregon	11.8	11.8 (34)	(1)	88	86	2
33. Massachusetts	11.9	11.9 (35)	(1)	374	366	8
34. New Mexico	12.3	12.5 (37)	(1)	64	60	4
35. Ohio	12.6	12.2 (36)	18.9 (18)	641	591	50
36. South Carolina	13.0	8.2 (11)	18.4 (17)	255	85	170
37. Maryland	13.0	11.1 (33)	21.6 (20)	182	126	56
38. Indiana	13.4	12.9 (39)	27.2 (23)	348	323	25
39. Illinois	13.5	12.7 (38)	29.2 (25)	742	662	80
40. Idaho	13.6	13.3 (41)	(1)	61	59	2
41. Nevada	13.8	14.9 (43)	(1)	10	10	----
42. Montana	14.8	14.8 (42)	(1)	64	61	3
43. New York	16.0	15.3 (44)	32.2 (26)	1,474	1,342	132
44. Pennsylvania	16.4	15.9 (47)	26.4 (22)	1,299	1,199	100
45. New Jersey	17.1	15.9 (46)	35.0 (27)	509	444	65
46. District of Columbia	17.8	13.1 (40)	27.2 (24)	68	33	35
47. Colorado	18.7	18.8 (48)	(1)	165	163	2
48. Delaware	19.2	15.8 (45)	(1)	37	26	11
49. Utah	22.4	22.0 (49)	(1)	116	112	4

[1] Rates for nonwhite children not shown because of small numbers of nonwhite children in 22 States. In all others except 3 States the nonwhite population at risk in the 3-year period under observation was above 100,000; in 3 listed States (Arizona, Kansas, Indiana) less than 100,000, but above 50,000.

[2] It should be noted that the bracketed rank numbers of the nonwhite are not comparable with those of the white because they refer only to 27 States in which rates for nonwhite children are shown; however, they indicate the rank order of these States for the nonwhite children.

from rheumatic heart diseases (5.3), as a fact the lowest among the States for all children and white children alike (there are almost no nonwhite children in Vermont); the case for Maine (7.6) is similar. Arizona has also a relatively favorable rate for white children (8.0) in contrast to all other States in the Mountain region. On the other hand, Oregon in the Pacific group has a rather high rate (11.8) and Delaware in the South Atlantic division exhibits a very unfavorable rate even for the white children alone (15.8), hardly different from the high rates in the three Middle Atlantic States (New York, Pennsylvania, New Jersey), and markedly surpassed only by the rates in Colorado (18.8) and Utah (22.0).

The rank order for nonwhite children is likewise shown in brackets, in the same table. However, only those States are shown in which the death rates are based on a population at risk of at least 50,000 observation years, because the rates in the other States are subject to large chance fluctuations. There are 27 States ranked according to mortality from acute rheumatic fever plus diseases of the heart in nonwhite children, 5 through 19 years. In only three of these States (Arizona, Kansas, Indiana) the population at risk was below 100,000 but above 50,000 observations years.

The rank order of the States for the nonwhite children resembles, by and large, that of the white children; low rates occur in the South and Pacific, high rates in the Northeast, again especially in the Middle Atlantic States. It is only in the Mountain States that the rank order differs essentially from that of the white children; in these States the nonwhite children exhibit relatively favorable rates (as best seen from the rank order of the geographic divisions in table VI, where Mountain as a whole occupies third lowest place). The rates in the following States are in the lowest quartile: Arkansas (8.8), Arizona (9.6), Oklahoma (9.7), Mississippi (9.8), California (12.0), Texas (12.8), Florida (12.8), all definitely below the nation's average of 16.6 for nonwhite children; above this average in the quartile with highest mortality were: Michigan (23.1), Pennsylvania (26.4), Indiana (27.2), District of Columbia (27.2), Illinois (29.2), New York (32.2), and New Jersey (35.0).

There can hardly be much doubt, then, that beyond social-environmental influences both in white and nonwhite children a certain climatic-geographic factor plays a role in mortality from rheumatic fever and heart diseases. This is clearly seen when the death rates of the white and nonwhite groups are considered separately, or as was shown above for the geographic divisions when the total rates are adjusted for a constant proportion of these race (socio-economic) groups.

VII. Summary

1. Total Death Toll

During the three years from 1939 to 1941, 12,037 deaths from heart diseases (all forms) and 2,538 deaths from acute rheumatic fever were counted in persons under 20 years of age; altogether 14,575 deaths. Considering that in the age group under 5 years most fatal heart diseases are not of rheumatic origin and that in later childhood (5 through 19 years) some deaths from heart diseases (perhaps 10 percent) may also not be of rheumatic etiology, there remains a minimum of approximately 12,000 deaths caused by acute rheumatic fever and its aftereffects in the years of childhood.

2. Weight Among Other Leading Causes of Death

By comparing the six leading causes of death in school age and youth (5–9, 10–14, and 15–19 years) it can be seen that, disregarding accidents, with increasing age of the children mortality from acute rheumatic fever plus diseases of the heart holds an increasingly high place among fatal diseases in the white population. In the nonwhite by far the greatest killer is still tuberculosis, especially for the girls entering the childbearing age. But it is remarkable also that the same nonwhite girls, 15–19 years old, suffer a decidedly higher mortality from heart diseases than the nonwhite boys of this age, which parallels the situation in tuberculosis mortality.

From this statistical result, and others listed, it follows that rheumatic fever resembles in its epidemiology tuberculosis in various aspects. These findings stress the fact that in rheumatic fever, as in tuberculosis, the social factor plays a part in the cure or fatal outcome of the disease.

3. Trend in Mortality From Rheumatic Fever

Average annual death rates are shown for the comparable 3-year periods 1919–21, 1929–31, and

1939–41, supplemented by data for the single years 1942, 1943, and 1944 in the total United States. The white children, in the three age groups from 5 through 19 years, exhibit a very distinct decrease in mortality from acute rheumatic fever and from diseases of the heart. This decrease is in the neighborhood of 70 percent for the age groups 5–9 and 10–14, and of 60 percent for the age group 15–19 years. But for the nonwhite children no consistent downward trend is visible, except in the oldest age group 15–19 years; even this decrease is far behind that of the white adolescents in both sexes and amounts to hardly more than 25 percent from 1919–21 to the last report in 1944. For acute rheumatic fever alone there is even an apparent increase in the two younger age groups of the nonwhite children, as illustrated by index figures. The latter results might be due to deficient reporting in the beginning of the period and would then present an artificial product. It appears from the reported figures that in the early period (1919–21) the nonwhite children started with very low death rates, lower indeed in most instances than those of the white children. This result is contrary to later experience in the detailed study of the 1939–41 period, when the nonwhite children almost everywhere demonstrate consistently higher death rates from rheumatic fever and heart diseases than the whites.

4. Age Differential

The death rates are shown separately for acute rheumatic fever, chronic rheumatic diseases of the heart, and heart diseases (all forms), by race and sex in the four age groups, under 5, 5–9, 10–14, and 15–19 years. Disregarding the group of preschool children under 5 years, we observe that with increasing age, in both sexes and both racial groups, there is a distinct increase in the death rates for chronic rheumatic diseases of the heart and heart diseases (all forms). Since the deaths listed on the death certificates as due to chronic rheumatic diseases of the heart are an evident understatement, mortality from all heart diseases in children 5–19 years is taken as a better estimate or "index of rheumatic heart disease mortality." (O. F. Hedley.) To this index the deaths from acute rheumatic fever can easily be added to get the total death toll from acute rheumatic fever and its consequences.

5. Race Differential

The race differential in the country as a whole is demonstrated by the ratios of the death rates, nonwhite to white. They show that in almost all age-sex groups and for all three listed causes the mortality rates of the nonwhite exceed those of the white children. Though this overmortality of the nonwhite race is not so great as in some other diseases (tuberculosis, syphilis, malaria), the consistent difference tends to show that rheumatic fever and heart diseases are unfavorably influenced by adverse socio-economic conditions.

The race differences in the geographic divisions are more closely tested by considering the chance errors of the death rates. The main outcome of this comparison between white and nonwhite is that in most geographic divisions the higher mortality of the nonwhite children is evident, though the differences, even high ones as in New England or West North Central, are not always statistically significant. The race differences have the greatest significance in the Middle Atlantic (high differences) and the South Atlantic (low differences). There is only one consistent exception, the Mountain division, which shows higher death rates for the white children as compared with the nonwhite.

6. Sex Differential

The behavior of the sexes in mortality from rheumatic fever and heart disease is shown by the ratios of the death rates, male to female, for the United States as a whole. These ratios reveal that there is little consistent sex difference for mortality from rheumatic diseases in the total United States except in the age group of the older children 15–19 years. In this age group the nonwhite females show distinctly higher mortality rates than the nonwhite males while in the white group the rate for females is lower than for males. The sex differences in the nine geographic divisions reveal a very similar result. In all nine divisions the white boys have higher death rates than the white girls; in all divisions except Mountain and Pacific, the nonwhite girls exhibit a markedly higher mortality than the nonwhite boys.

7. Regional Variations

Mortality from acute rheumatic fever and diseases of the heart varies among the geographic division of the United States. The test methods applied confirm that, in general, for both white and nonwhite children, the death rates for acute rheumatic fever plus heart diseases are below average in the South while in the Northeast, especially in the Middle Atlantic division, they

are significantly above average. In the Pacific division the death rates are as low as in the South and significantly below the country's average, while in the Mountain division they are exceptionally high for the white children in all age groups.

This geographic tendency becomes still more evident when the race distribution of white and nonwhite children is kept constant by adjusted rates, or when the rates are considered separately for white and nonwhite.

8. State Comparisons

To obtain a rank order of States in childhood mortality from rheumatic heart diseases and to make State-to-State comparisons more easily possible, the three age groups, the sexes, and the two race groups are combined in a single rate for each State (crude death rate); in addition, death rates are shown for the white and nonwhite children separately. The range of the crude rates for mortality from acute rheumatic fever plus diseases of the heart was somewhat greater than four-fold, from 5.3 in Vermont to 22.4 in Utah, about the average for the United States of 11.7 per 100,000; the median position among the 49 States (including the District of Columbia) was occupied by Connecticut with a rate of 10.6. The results for the States confirm, with a few exceptions (Vermont and Maine in New England with low rates; Oregon in the Pacific and Delaware in the South Atlantic with relatively high rates) that in general the death rates are lower in the South than in the Northeast, especially than in the Middle Atlantic States; lower in the Pacific than in the Mountain States. This geographic tendency in the individual States becomes much more distinct if the rates for the white and nonwhite children are separately ranked, thus taking account of the greatly varying race composition of the individual States.

All combined (crude) rates necessarily obscure finer differences by age, race, and sex. Therefore age-race-sex specific death rates are given in Appendix B for the individual States in the same arrangement as for the geographic divisions; they will provide more detailed information of special interest for the local State health authorities and possibly be of value for further research work.

Appendix A

Reference Tables for Childhood Mortality From Acute Rheumatic Fever, Chronic Rheumatic Diseases of the Heart, and Diseases of the Heart (All Forms) by Age, Race, and Sex: United States and Geographic Divisions

In tables 1 and 2 the age-race-sex specific death rates per 100,000 population and the absolute numbers of the deaths from acute rheumatic fever, chronic rheumatic diseases of the heart, and diseases of the heart (all forms) are shown for the nine geographic divisions (New England, Middle Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central, Mountain, and Pacific) as compared with the total United States. In table 3 the population is correspondingly given for the nine geographic divisions by age, race, and sex.

The death rates for the small nonwhite population groups cannot be considered stable enough for adequate comparisons without showing the chance errors (see main part, tables V and VII). It is the usual practice in official vital statistics to publish the death rates without chance errors and this is satisfactory as long as the figures deal with large enough populations. Most rates in vital statistics of the total United States are based on large population numbers. Their validity is equally good for more or less frequent causes of death provided that the underlying source materials (the medical diagnoses on the death certificates) are exact. They are related to the same large population at risk and, as a rule, need not be characterized by adding chance errors or by other test methods. Only when the population is subdivided into many characteristics (age, race, sex, urban, rural, etc.) and when geographic or local subdivisions are compared, do the rates become unstable; then the statistical consideration of chance fluctuations becomes necessary for a finer analysis. This has been shown for the geographic divisions in the main part; it will be shown for the States in Appendix B.

Practical experience in vital statistics and theoretical experiments based on the sampling theory for different sizes of population make it appear that in practical usage a population of 100,000 person-years is a reasonable minimum on which to base comparisons of differential mortality rates. Such a minimum of lives exposed to risk means for a 3-year period of observation an actual population of between 30,000 and 35,000, for a 5-year period a population of 20,000, in each age-race-sex group under examination. In general, death rates on this basis need not be critically scrutinized relative to their respective chance fluctuations. However, since the stability of the rates depends on the population at risk as well as on the frequency of the event, in questionable cases the significance of a difference will have to be tested.

For these reasons, in table 1 all rates based on a population at risk of less than 100,000 are put in brackets, and in table 4, which shows the ratios of the death rates, nonwhite to white, these rates are not used for computing further derived values such as ratios of the death rates.[1]

[1] It must be emphasized that these rates are not disregarded because they represent genuinely rare events or a few frequencies only in the respective population groups, but because they are based on small population numbers. For instance, in New England the deaths from rheumatic diseases of the nonwhite are not genuine rare events in

In table 4 the ratios of the death rates, nonwhite to white, are shown in the nine geographic divisions for each of the three causes of death in both sexes and all four age groups. Ratios are not shown for groups with a population of less than 100,000 person-years at risk. A glance at the ratios will show that in almost all regions the nonwhite group has a higher mortality from acute rheumatic fever, chronic rheumatic heart diseases, and heart diseases (all forms) than the white. Thus the results in the geographic divisions confirm in greater detail what has been stated before (main part, table III) for the United States as a whole, with few exceptions, and so strengthen the inference that socio-economic factors play a part in mortality from rheumatic fever diseases.

Considering the single ratios of nonwhite-to-white mortality in the divisions, it will be recalled that in the total United States all ratios are somewhat above 1 and seldom above 2, the only exception being chronic rheumatic diseases of the heart among 15 to 19 year-old boys for which the nonwhite exhibit a somewhat lower mortality than the white boys. In the geographic divisions the variation of the ratios, nonwhite to white, is much higher, and there are also a few more exceptions with ratios below 1, which means occasionally a lower mortality for the nonwhite children than for the white in certain divisions. In general the ratios are above 1, and in quite a few instances above 2, characterizing the higher mortality of the nonwhite children (see the detailed ratios in table 4).

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comparison with those of the white; on the contrary, they would probably turn out to be comparatively more frequent (as can be concluded from regions with large numbers of nonwhite children). The obtained values are unreliable because the observations of those exposed to risk were not sufficient. Even if the events are really rare for large numbers of lives at risk, i. e., the probability of dying from a certain cause is very small, such rare events follow the laws of chance just as much as more frequent events with higher probabilities (34, 35, 36).

These considerations are of importance in the present investigation insofar as this so-called "law of small numbers" (v. Bortkiewicz), which is only a special case of Poisson's "law of large numbers," proves that what makes the death rates unreliable is not (as is sometimes assumed) the small frequencies, i. e. the few deaths from certain causes, but rather the small population numbers to which the deaths are related. If the death rates originate from large enough populations they represent stable events which may occur more or less frequently.

Table 1.—Death rates for acute rheumatic fever, chronic rheumatic diseases of the heart, and diseases of the heart (all forms), in persons under 20 years, by age, race, and sex: United States and geographic divisions, 1939–41

AVERAGE ANNUAL RATES PER 100,000

Area	White						Nonwhite					
	Acute rheumatic fever		Chronic rheumatic diseases of the heart		Diseases of the heart (all forms)		Acute rheumatic fever		Chronic rheumatic diseases of the heart		Diseases of the heart (all forms)	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Under 5 years												
United States	0.7	0.7	0.9	0.8	6.7	5.9	0.9	1.5	1.6	1.8	8.9	8.9
New England	.7	1.0	.3	.6	5.2	3.9	[0]	[0]	[0]	[8.1]	[0]	[24.2]
Middle Atlantic	.9	1.2	1.4	1.2	7.2	5.8	.7	1.4	4.2	5.6	14.9	14.1
East North Central	.5	.7	.6	.6	5.6	5.5	4.9	4.0	4.0	4.8	8.1	9.6
West North Central	.7	1.0	.7	.9	6.0	5.1	[0]	[0]	4.0	[2.0]	10.0	[12.0]
South Atlantic	.8	.5	.8	.8	7.1	6.5	.9	1.5	.8	1.6	10.0	10.2
East South Central	1.3	.5	1.7	.6	8.1	6.9	.5	1.3	1.1	.9	5.7	4.7
West South Central	.3	.3	.9	1.0	8.6	8.0	.5	1.6	2.1	.8	9.1	8.8
Mountain	1.0	.7	1.4	1.6	6.0	6.7	[0]	[0]	[0]	[0]	[0]	[8.9]
Pacific	.3	.7	.5	.3	5.4	4.1	[0]	[0]	[0]	[0]	[10.9]	[2.8]
5–9 years												
United States	2.1	2.4	3.0	3.2	5.5	5.6	2.9	3.7	4.7	5.1	9.3	9.3
New England	.7	1.5	2.5	2.7	4.6	4.4	[7.4]	[0]	[7.4]	[14.8]	[7.4]	[14.8]
Middle Atlantic	2.7	3.4	4.7	5.1	7.1	7.4	6.5	5.7	14.3	14.7	22.1	19.8
East North Central	2.7	2.6	3.2	3.6	6.1	6.3	7.8	9.3	6.2	8.5	9.4	13.1
West North Central	1.6	1.7	1.9	2.5	4.1	5.2	[0]	[7.8]	[11.9]	[11.6]	[15.9]	[11.6]
South Atlantic	2.1	2.2	2.3	2.5	4.9	5.0	2.1	3.9	3.9	4.2	9.1	9.0
East South Central	1.9	2.2	3.2	1.9	6.1	4.5	3.3	2.6	2.6	3.3	6.8	7.9
West South Central	1.5	2.3	1.8	1.6	4.3	3.4	1.3	2.1	3.4	2.8	7.0	6.2
Mountain	2.9	2.0	4.2	5.2	8.1	8.3	[0]	[0]	[6.5]	[3.1]	[6.5]	[6.3]
Pacific	.9	1.6	1.8	2.3	3.6	4.9	[2.6]	[0]	[5.2]	[5.3]	[10.5]	[5.3]
10–14 years												
United States	2.4	2.5	5.3	5.8	8.8	9.2	3.8	4.2	6.2	7.1	11.3	13.2
New England	2.2	2.2	6.1	5.0	9.1	7.6	[6.7]	[6.5]	[13.4]	[13.0]	[20.1]	[13.0]
Middle Atlantic	3.2	3.1	9.0	9.6	12.0	13.5	7.2	7.5	17.5	20.9	22.3	27.9
East North Central	2.3	3.3	5.0	6.2	9.1	10.1	5.8	3.5	7.3	18.2	12.3	28.7
West North Central	2.0	2.3	4.1	4.3	8.3	7.3	[3.8]	[1.9]	[11.4]	[7.6]	[11.4]	[11.4]
South Atlantic	2.2	2.3	3.1	4.0	6.4	6.7	4.9	4.7	4.6	5.3	10.6	12.4
East South Central	2.2	2.2	4.6	3.6	7.8	6.6	1.7	4.2	3.9	3.3	7.9	7.4
West South Central	1.6	1.6	2.7	3.0	5.7	6.5	2.0	2.5	6.4	4.5	11.7	10.3
Mountain	3.5	2.5	8.1	10.7	13.0	15.4	[0]	[7.2]	[0]	[7.2]	[14.2]	[7.2]
Pacific	2.0	1.6	3.6	3.4	5.6	6.2	2.1	2.2	4.2	8.9	6.4	11.2
15–19 years												
United States	1.6	1.4	6.7	5.7	12.7	11.2	2.2	2.2	6.2	7.8	15.7	21.6
New England	1.5	1.1	7.6	6.4	13.6	11.7	[0]	[18.9]	[26.1]	[18.9]	[26.1]	[25.2]
Middle Atlantic	2.2	2.0	11.9	10.3	18.0	16.7	3.2	6.5	16.8	20.5	23.9	29.3
East North Central	1.4	1.4	6.3	5.5	13.0	12.1	5.3	3.5	12.1	14.7	18.9	25.9
West North Central	1.8	1.2	3.8	4.1	9.7	8.5	[0]	[1.9]	[2.0]	[15.1]	[6.0]	[24.5]
South Atlantic	1.5	1.5	4.5	4.4	9.6	8.5	2.4	1.5	5.0	6.0	15.1	22.7
East South Central	1.1	1.4	4.9	3.2	10.8	7.8	1.4	1.3	4.3	6.2	14.3	20.3
West South Central	1.6	.9	3.9	2.7	9.7	7.9	1.1	2.0	4.0	3.8	13.2	16.6
Mountain	2.9	1.9	9.5	6.7	17.2	14.1	[3.9]	[0]	[11.6]	[4.0]	[34.7]	[8.0]
Pacific	.9	.7	4.2	3.2	9.1	6.7	[3.4]	[1.9]	[5.1]	[11.5]	[18.7]	[19.2]

NOTE.—Rates are bracketed when based on a population group at risk less than 100,000 in the 3 years under observation.

Table 2.—Deaths from acute rheumatic fever, chronic rheumatic diseases of the heart, and diseases of the heart (all forms) in persons under 20 years, by age, race, and sex: United States and geographical divisions, 1939–41

ABSOLUTE NUMBERS FOR 3 YEARS

Area	White						Nonwhite					
	Acute rheumatic fever		Chronic rheumatic diseases of the heart		Diseases of the heart (all forms)		Acute rheumatic fever		Chronic rheumatic diseases of the heart		Diseases of the heart (all forms)	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Under 5 years												
United States	103	100	130	115	939	799	18	30	32	35	174	176
New England	6	8	3	5	45	32	-	-	-	1	-	3
Middle Atlantic	25	30	36	31	190	146	1	2	6	8	21	20
East North Central	16	19	18	17	165	156	6	5	5	6	10	12
West North Central	12	15	11	14	96	78	-	-	2	1	5	6
South Atlantic	15	8	15	14	129	114	7	11	6	12	75	77
East South Central	16	6	21	7	99	82	2	6	5	4	25	21
West South Central	4	4	13	15	128	115	2	6	8	3	34	33
Mountain	6	4	8	9	35	38	-	-	-	-	-	3
Pacific	3	6	5	3	52	38	-	-	-	-	4	1
5–9 years												
United States	294	327	424	438	789	776	58	75	96	104	189	190
New England	6	13	23	24	42	39	1	-	1	2	1	2
Middle Atlantic	77	92	133	138	199	201	10	9	22	23	34	31
East North Central	77	73	91	100	175	176	10	12	8	11	12	17
West North Central	26	26	30	38	65	81	-	4	6	6	8	6
South Atlantic	39	39	42	44	90	89	16	30	30	33	70	70
East South Central	23	26	39	23	75	53	15	12	12	15	31	36
West South Central	22	33	27	23	65	49	5	8	13	11	27	24
Mountain	16	11	23	28	45	45	-	-	2	1	2	2
Pacific	8	14	16	20	33	43	1	-	2	2	4	2
10–14 years												
United States	378	389	839	889	1, 381	1, 408	78	89	128	149	235	277
New England	23	23	65	51	96	78	1	1	2	2	3	2
Middle Atlantic	107	99	297	310	397	436	12	13	29	36	37	48
East North Central	75	104	161	196	297	318	8	5	10	26	17	41
West North Central	35	38	71	73	145	122	2	1	6	4	6	6
South Atlantic	44	43	61	76	125	126	38	37	36	42	83	98
East South Central	28	27	59	45	100	82	8	19	18	15	36	34
West South Central	26	25	43	46	91	101	8	10	25	18	46	41
Mountain	20	14	46	59	74	85	-	2	-	2	4	2
Pacific	20	16	36	33	56	60	1	1	2	4	3	5
15–19 years												
United States	273	236	1, 116	938	2, 107	1, 827	43	47	124	166	313	457
New England	17	12	86	72	151	131	-	3	4	3	4	4
Middle Atlantic	78	72	424	362	640	587	5	11	26	35	37	50
East North Central	48	49	219	187	450	412	7	5	16	21	25	37
West North Central	34	22	70	74	179	153	-	1	1	8	3	13
South Atlantic	30	30	90	87	192	168	18	12	38	49	115	184
East South Central	14	18	61	40	135	97	6	6	18	28	60	91
West South Central	25	14	63	43	155	125	4	8	15	15	49	66
Mountain	17	11	55	38	99	80	1	-	3	1	9	2
Pacific	10	8	48	35	103	74	2	1	3	6	11	10

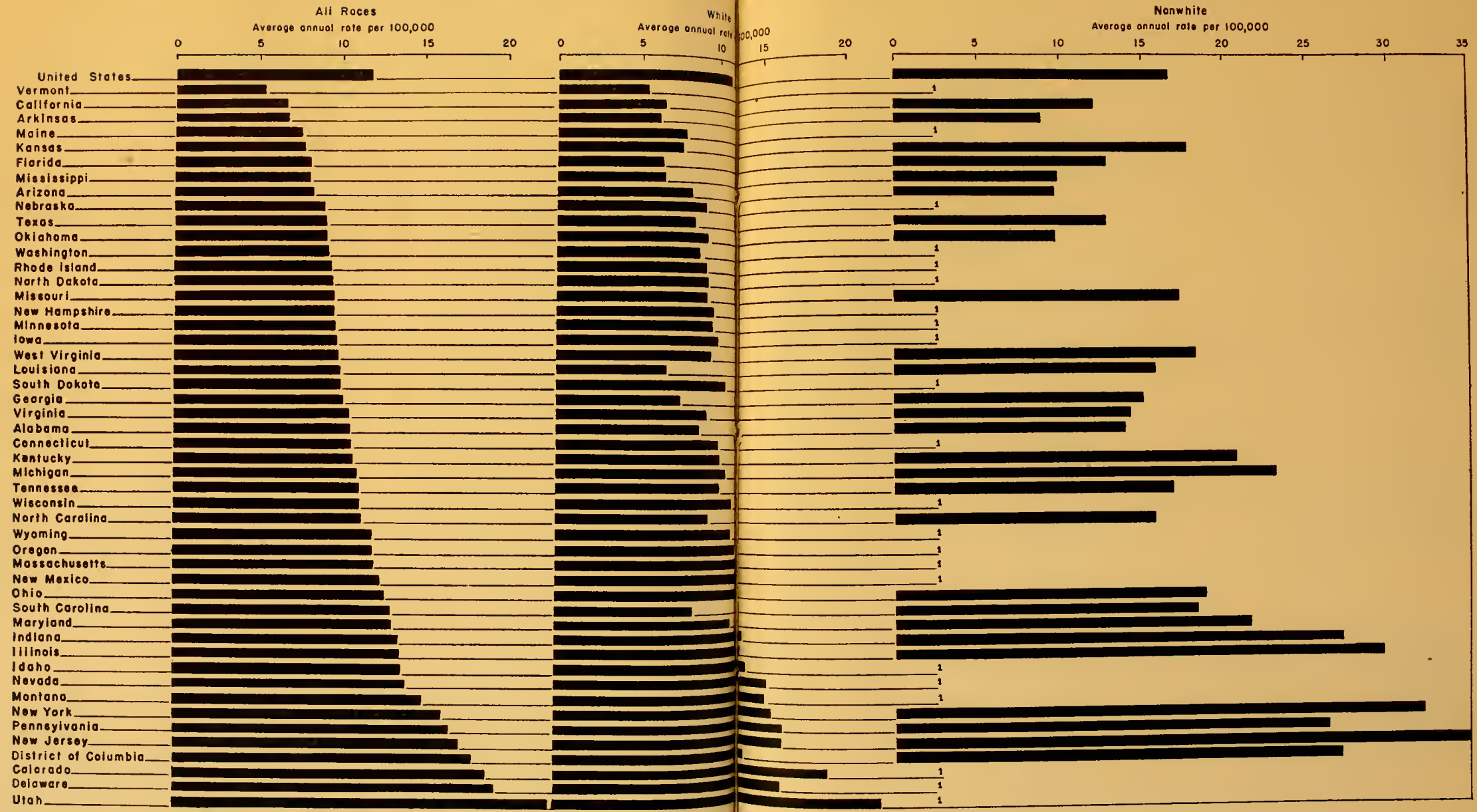

FIGURE 2.—Death Rates for Acute Rheumatic Fever plus Diseases of the Heart in Children 5 through 19 Years of Age, by Race: United States and Each State, 1939–41.

[1] Rates not shown because of the small number of nonwhite children in the State (see table VIII).

Table 3.—Population under 20 years by age, race, and sex: United States and geographic divisions, Census of 1940

Area	White		Nonwhite	
	Male	Female	Male	Female
	Under 5 years			
United States	4, 701, 470	4, 528, 035	653, 338	658, 681
New England	287, 711	276, 722	4, 160	4, 134
Middle Atlantic	879, 909	843, 898	47, 071	47, 235
East North Central	981, 694	943, 621	41, 186	41, 476
West North Central	533, 651	512, 156	16, 715	16, 635
South Atlantic	602, 747	582, 752	249, 972	252, 437
East South Central	406, 614	393, 682	146, 746	148, 881
West South Central	494, 692	479, 474	124, 082	124, 887
Mountain	194, 380	188, 250	11, 200	11, 233
Pacific	320, 072	307, 480	12, 206	11, 763
	5–9 years			
United States	4, 744, 537	4, 584, 414	674, 286	681, 385
New England	307, 314	396, 331	4, 533	4, 490
Middle Atlantic	934, 192	900, 916	51, 345	52, 184
East North Central	960, 745	924, 892	42, 707	43, 193
West North Central	533, 974	514, 978	16, 801	17, 188
South Atlantic	607, 902	588, 628	256, 178	259, 405
East South Central	409, 034	396, 452	150, 969	152, 067
West South Central	502, 509	487, 162	128, 785	129, 600
Mountain	184, 293	179, 946	10, 231	10, 615
Pacific	304, 574	295, 109	12, 737	12, 643
	10–14 years			
United States	5, 259, 007	5, 093, 688	693, 322	699, 918
New England	352, 514	341, 673	4, 975	5, 109
Middle Atlantic	1, 104, 310	1, 073, 889	55, 266	57, 429
East North Central	1, 084, 085	1, 048, 609	45, 960	47, 629
West North Central	580, 686	560, 772	17, 534	17, 569
South Atlantic	653, 164	630, 848	260, 847	263, 474
East South Central	427, 448	411, 822	152, 707	152, 319
West South Central	533, 659	518, 025	130, 918	132, 211
Mountain	189, 383	183, 879	9, 407	9, 271
Pacific	333, 758	324, 171	15, 708	14, 907
	15–19 years			
United States	5, 515, 920	5, 448, 127	664, 233	705, 243
New England	378, 520	374, 138	5, 099	5, 282
Middle Atlantic	1, 183, 667	1, 174, 516	51, 559	56, 796
East North Central	1, 149, 861	1, 132, 506	44, 070	47, 568
West North Central	612, 653	602, 011	16, 778	17, 709
South Atlantic	668, 997	661, 009	254, 432	270, 335
East South Central	417, 493	414, 813	140, 041	149, 442
West South Central	535, 258	530, 772	124, 046	132, 380
Mountain	192, 265	188, 814	8, 646	8, 363
Pacific	377, 206	369, 548	19, 562	17, 368

Table 4.—Ratios of death rates: Nonwhite to white, for acute rheumatic fever, chronic rheumatic diseases of the heart, and diseases of the heart (all forms), by age and sex: United States and geographic divisions, 1939–41

Area	Acute rheumatic fever		Chronic rheumatic diseases of the heart		Diseases of the heart (all forms)		Acute rheumatic fever		Chronic rheumatic diseases of the heart		Diseases of the heart (all forms)	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
	Under 5 years						5–9 years					
United States	1.3	2.1	1.8	2.3	1.3	1.5	1.4	1.5	1.6	1.6	1.7	1.7
New England [1]												
Middle Atlantic	.8	1.2	3.0	4.7	2.1	2.4	2.4	1.7	3.0	2.9	3.1	2.7
East North Central	9.8	5.7	6.7	8.0	1.4	1.7	2.9	3.6	1.9	2.4	1.5	2.1
West North Central [1]												
South Atlantic	1.1	3.0	1.0	2.0	1.4	1.6	1.0	1.8	1.7	1.7	1.9	1.8
East South Central	.4	2.6	.6	1.5	.7	.7	1.7	1.2	.8	1.7	1.1	1.8
West South Central	1.7	5.3	2.3	.8	1.1	1.1	.9	.9	1.9	1.8	1.6	1.8
Mountain [1]												
Pacific [1]												
	10–14 years						15–19 years					
United States	1.6	1.7	1.2	1.2	1.3	1.4	1.4	1.6	.9	1.4	1.2	1.9
New England [1]												
Middle Atlantic	2.3	2.4	1.9	2.2	1.9	2.1	1.5	3.3	1.4	2.0	1.3	1.8
East North Central	2.5	1.1	1.5	2.9	1.4	2.8	3.8	2.5	1.9	2.7	1.5	2.1
West North Central [1]												
South Atlantic	2.2	2.0	1.5	1.3	1.7	1.9	1.6	1.0	1.1	1.4	1.6	2.7
East South Central	.8	1.9	.8	.9	1.0	1.1	1.3	.9	.9	1.9	1.3	2.6
West South Central	1.3	1.6	2.4	1.5	2.1	1.6	.7	2.2	1.0	1.4	1.4	2.1
Mountain [1]												
Pacific [1]												

[1] Ratios: Nonwhite to white are not shown for population groups of less than 100,000 nonwhite.

Appendix B

Childhood Mortality From Acute Rheumatic Fever, Chronic Rheumatic Diseases of the Heart (All Forms) by Age, Race, and Sex: Geographic Divisions and the Individual States.

To illustrate differential mortality from rheumatic fever in the individual States we will restrict the tabulations to the age-race-sex specific death rates, the deaths, and the respective population numbers at risk in the 3-year period under observation (1939–41). However, in conspicuous cases differences can easily be tested by one method or another, as all necessary materials for the test methods are given in the following tables. In some cases the differences and their significance will be shown and discussed in the text.

New England States

Tables 5 (a and b) and 6 show the death rates for the three listed causes (acute rheumatic fever, chronic rheumatic diseases of the heart, and diseases of the heart, all forms); the corresponding number of the deceased persons in the 3 years; and the census population of 1940 for the New England States: Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut. As in the case of the divisions, death rates in the individual States are deemed valid for inter-State comparisons only when they are based on a population of 100,000 or more person-years in the 3 years of observation. Even in the total division of New England the rates for the nonwhite population are subject to large chance fluctuations, and are therefore put in brackets unless standard errors are added. The same holds for the white children in New Hampshire, Vermont, and Rhode Island, whose population numbers do not reach the desirable level.

Indeed, it will be seen from table 5 (a and b) that the bracketed rates for the white children show a wide and irregular variation among the States, just as the rates in total New England do for the nonwhite children. We will concentrate the discussion on mortality from heart disease (all forms) as the most important group of rheumatic deaths, but occasionally we will mention the other listed items. Disregarding the age group under 5 for the reasons given before, we find, for instance, no death at all from the three listed items among white children 5–9 years old, in the State of Vermont. In a population of only about 15,000, exposed to risk for 3 years, this might be a casual result. In the next age group, 10–14 years, there occurs in Vermont a rather high death rate for all heart diseases with 12.1 per 100,000 boys, against the low rate of 2.1 for the girls. But even this high sex difference of 10.0 yields such a high standard error (± 5.37) that it can be attributed to mere chance. In the next age group, 15–19 years, we find in Vermont low death rates and a relatively small sex difference for heart diseases; on the other hand a high death rate is noticeable for acute rheumatic fever among females, 8.4 per 100,000, as against 2.0 for males. This sex difference is also statistically insignificant as are all the other differences in rates for boys as compared with girls in this division.

These examples are chosen only to demonstrate

Table 5a.—Mortality from acute rheumatic fever, chronic rheumatic diseases of the heart, and diseases of the heart (all forms) in persons under 20 years, by age, race, and sex: *New England* and individual States, 1939–41

A. AVERAGE ANNUAL RATES PER 100,000

Area	White						Nonwhite					
	Acute rheumatic fever		Chronic rheumatic diseases of the heart		Diseases of the heart (all forms)		Acute rheumatic fever		Chronic rheumatic diseases of the heart		Diseases of the heart (all forms)	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Under 5 years												
New England	0.7	1.0	0.3	0.6	5.2	3.9	[0]	[0]	[0]	[8.1]	[0]	[24.2]
Maine	1.9	1.9	0	1.0	7.6	2.9	------	------	------	------	------	------
New Hampshire	[3.7]	[1.9]	[0]	[0]	[5.5]	[1.9]	------	------	------	------	------	------
Vermont	[0]	[0]	[2.2]	[0]	[8.7]	[2.3]	------	------	------	------	------	------
Massachusetts	.2	1.0	.2	.2	4.2	4.7	------	------	------	------	------	------
Rhode Island	[0]	[0]	[0]	[1.5]	[4.3]	[1.5]	------	------	------	------	------	------
Connecticut	.6	.6	.6	1.3	5.5	4.5	------	------	------	------	------	------
5–9 years												
New England	.7	1.5	2.5	2.7	4.6	4.4	[7.4]	[0]	[7.4]	[14.8]	[7.4]	[14.8]
Maine	0	.9	.9	1.8	3.6	3.7	------	------	------	------	------	------
New Hampshire	[1.7]	[3.6]	[0]	[0]	[1.7]	[1.8]	------	------	------	------	------	------
Vermont	[0]	[0]	[0]	[0]	[0]	[0]	------	------	------	------	------	------
Massachusetts	.9	1.1	4.6	3.8	6.6	6.3	------	------	------	------	------	------
Rhode Island	[0]	[0]	[0]	[0]	[5.3]	[0]	------	------	------	------	------	------
Connecticut	.6	3.0	.6	3.0	1.7	3.6	------	------	------	------	------	------
10–14 years												
New England	2.2	2.2	6.1	5.0	9.1	7.6	[6.7]	[6.5]	[13.4]	[13.0]	[20.1]	[13.0]
Maine	3.4	1.8	2.6	0	6.0	.9	------	------	------	------	------	------
New Hampshire	[7.9]	[0]	[9.5]	[4.9]	[12.6]	[8.2]	------	------	------	------	------	------
Vermont	[0]	[0]	[8.1]	[0]	[12.1]	[2.1]	------	------	------	------	------	------
Massachusetts	2.3	2.3	5.8	6.2	9.2	9.5	------	------	------	------	------	------
Rhode Island	[0]	[1.1]	[5.6]	[4.5]	[5.6]	[6.8]	------	------	------	------	------	------
Connecticut	1.0	4.0	7.7	6.0	10.2	8.1	------	------	------	------	------	------
15–19 years												
New England	1.5	1.1	7.6	6.4	13.6	11.7	[0]	[18.9]	[26.1]	[18.9]	[26.1]	[25.2]
Maine	1.7	1.7	5.0	3.4	14.2	6.9	------	------	------	------	------	------
New Hampshire	[1.5]	[0]	[4.6]	[4.6]	[6.1]	[10.8]	------	------	------	------	------	------
Vermont	[2.0]	[8.4]	[2.0]	[0]	[4.0]	[2.1]	------	------	------	------	------	------
Massachusetts	1.4	.4	10.0	7.6	16.0	13.4	------	------	------	------	------	------
Rhode Island	3.9	[0]	2.9	[8.1]	10.7	[16.2]	------	------	------	------	------	------
Connecticut	.4	1.8	7.0	6.2	12.7	10.1	------	------	------	------	------	------

Table 5b.—Mortality from acute rheumatic fever, chronic rheumatic diseases of the heart, and diseases of the heart (all forms) in persons under 20 years, by age, race, and sex: *New England* and individual States, 1939–41

B. ABSOLUTE NUMBER OF DEATHS IN 3 YEARS

Under 5 years												
New England	6	8	3	5	45	32	------	------	------	1	------	3
Maine	2	2	------	1	8	3	------	------	------	------	------	------
New Hampshire	2	1	------	------	3	1	------	------	------	------	------	------
Vermont	------	------	1	------	4	1	------	------	------	------	------	------
Massachusetts	1	4	1	1	18	19	------	------	------	1	------	2
Rhode Island	------	------	------	1	3	1	------	------	------	------	------	------
Connecticut	1	1	1	2	9	7	------	------	------	------	------	1

Table 5b.—Mortality from acute rheumatic fever, chronic rheumatic diseases of the heart, and diseases of the heart (all forms) in persons under 20 years, by age, race, and sex: *New England* and individual States, 1939–41—Continued

B. ABSOLUTE NUMBER OF DEATHS IN 3 YEARS—Continued

Area	White						Nonwhite					
	Acute rheumatic fever		Chronic rheumatic diseases of the heart		Diseases of the heart (all forms)		Acute rheumatic fever		Chronic rheumatic diseases of the heart		Diseases of the heart (all forms)	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
	5–9 years											
New England	6	13	23	24	42	39	1	------	1	2	1	2
Maine	------	1	1	2	4	4	------	------	------	------	------	------
New Hampshire	1	2	------	------	1	1	------	------	------	------	------	------
Vermont	------	------	------	------	------	------	------	------	------	------	------	------
Massachusetts	4	5	21	17	30	28	------	------	------	------	------	------
Rhode Island	------	------	------	------	4	------	------	------	1	1	1	1
Connecticut	1	5	1	5	3	6	1	------	------	1	------	1
	10–14 years											
New England	23	23	65	51	96	78	1	1	2	2	3	2
Maine	4	2	3	------	7	1	------	------	------	------	------	------
New Hampshire	5	------	6	3	8	5	------	------	------	------	------	------
Vermont	------	------	4	------	6	1	------	------	------	------	------	------
Massachusetts	12	12	31	32	49	49	------	------	1	------	2	------
Rhode Island	------	1	5	4	5	6	------	------	------	------	------	------
Connecticut	2	8	16	12	21	16	1	1	1	2	1	2
	15–19 years											
New England	17	12	86	72	154	131	------	3	4	3	4	4
Maine	2	2	6	4	17	8	------	------	------	------	------	------
New Hampshire	1	------	3	3	4	7	------	------	------	------	------	------
Vermont	1	4	1	------	2	1	------	------	------	------	------	------
Massachusetts	8	2	57	43	91	76	------	2	2	2	2	2
Rhode Island	4	------	3	8	11	16	------	------	1	------	1	------
Connecticut	1	4	16	14	29	23	------	1	1	1	1	2

NOTE.—Rates are bracketed when based on a population group at risk less than 100,000 in the 3 years under observation. Whenever this was the case for the total geographic division, rates are not shown at all for individual States therein.

Table 6.—Population under 20 years by age, race, and sex: *New England* and individual States, Census of 1940

Area	White		Nonwhite		White		Nonwhite	
	Male	Female	Male	Female	Male	Female	Male	Female
	Under 5 years				5–9 years			
New England	287, 711	276, 722	4, 160	4, 134	307, 314	296, 331	4, 533	4, 490
Maine	35, 316	34, 390	156	132	37, 349	36, 231	145	129
New Hampshire	18, 236	17, 527	20	22	19, 082	18, 380	15	19
Vermont	15, 246	14, 677	12	18	15, 382	14, 813	18	19
Massachusetts	141, 533	135, 975	2, 102	2, 087	152, 659	147, 435	2, 332	2, 316
Rhode Island	23, 240	22, 328	523	526	25, 351	24, 150	518	540
Connecticut	54, 140	51, 825	1, 347	1, 349	57, 491	55, 322	1, 505	1, 467
	10–14 years				15–19 years			
New England	352, 514	341, 673	4, 975	5, 109	378, 520	374, 138	5, 099	5, 282
Maine	39, 124	38, 078	128	129	39, 799	38, 704	142	134
New Hampshire	21, 122	20, 424	22	28	21, 774	21, 540	20	15
Vermont	16, 498	15, 810	23	13	16, 672	15, 888	19	20
Massachusetts	176, 925	171, 720	2, 650	2, 692	190, 039	189. 459	2, 853	2, 900
Rhode Island	30, 001	29, 453	581	589	34, 151	32, 826	591	613
Connecticut	68, 844	66, 188	1, 571	1, 658	76, 085	75, 721	1, 474	1, 600

that such differences between the single States of New England, inconsistent as they are, may be attributed to chance variation. The high variability makes it clear that these events (deaths from rheumatic fever and heart diseases in childhood) are not genuine rare events, even though occasionally not a single death has occurred in some of the smaller States. The death rates are unstable because they are based on an insufficient number of lives exposed to risk. If they are to be considered at all, chance errors must be allowed for.

The sex difference can in general be taken as a suitable criterion of the validity of the rates in mortality from rheumatic fever and heart diseases. As has been demonstrated for the stable rates of the total United States, the sex difference is usually small and insignificant, except perhaps in the age group of the adolescents, 15–19 years old. The sex difference in New England is insignificant for all age groups. It will further be observed from table 5 that among the single States of New England it is only in Massachusetts that no striking sex differences occur, and here they do not occur even in the age group 15–19 years. In fact, Massachusetts is the only New England State where the rates are based on a large enough population in each group of white children.

The geographic division as a whole has relatively favorable death rates for all forms of rheumatic diseases as compared with other regions of the Northeast, especially the Middle Atlantic division. This has been mentioned in the main discussion of the geographic differences. Within the New England group Massachusetts exhibits, in general, rates somewhat above the group average. This industrial and densely populated State seems to exhibit a tendency similar to that in the neighboring industrial States of the Middle Atlantic. This being the case, tests should be made to see whether the difference between mortality in Massachusetts and New England as a whole is significant before further conclusions can be drawn.[1]

If we now compute the differences and their standard errors between New England and Massachusetts, disregarding the age group under 5 years, the following values are obtained:

Differences for mortality from diseases of the heart (all forms) between New England and Massachusetts, 1939–41: White children:

	5–9 years	*10–14 years*	*15–19 years*
Male	-2.0 ± 0.71	-0.1 ± 0.93	-2.4 ± 1.09
Female	$-1.9 \pm .70$	$-1.9 \pm .86$	-1.7 ± 1.01

In all six instances the death rates in Massachusetts are higher (— sign) than in New England as a whole; in the age group 5–9 years, the differences are nearly three times their errors; in the age group 10–14 years, the difference is somewhat more than twice its error for the girls only, and in the age group 15–19 years the difference is of that significance for the boys only. Thus, we may conclude that Massachusetts shows a distinct tendency to higher mortality from heart diseases than the rest of the New England States.

[1] Massachusetts holds almost half the New England population. Since the errors in the rates of a total and subtotal are not independent, the standard error of the difference has to be computed by the formula employed above for testing the difference between the over-all rate in total United States and the geographic divisions. This formula $\left(E_{diff}=\sigma N\sqrt{\frac{N-n}{n}}\right.$; see page 19, footnote 5$\left.\right)$ simplifies in the present case of Massachusetts to approximately σN because the expression under the root becomes 1 or very close to 1, numerator and denominator being nearly equal.

Middle Atlantic States

Tables 7 (a and b) and 8 show the death rates for acute rheumatic fever, chronic rheumatic disof the heart, and heart diseases (all forms); the number of the corresponding deaths in the period 1939–41; and the number of children at the census enumeration for the Middle Atlantic States: New York, New Jersey, and Pennsylvania. It will be recollected that, in all age groups under consideration and in both race groups, mortality from rheumatic fever and heart diseases for this geographic division is distinctly above the United States average, and in fact (turning back to tables V and VI) higher than in any other division, apart from the exceptional group of the Mountain States.

Within the Middle Atlantic the variations between the three densely populated States are at first glance not very conspicuous, especially for the white children. The rates for the nonwhite children in the individual States are based on relatively small numbers and are therefore put in brackets as not reliable without showing their chance errors. This will be easily recognized if we again take as a criterion the sex difference which is inconsistent and occasionally high in

these States as compared with the parent universe. Even as high a sex difference as that in New York for the nonwhite group falls within the limit of hardly more than one standard error.

It will be seen from table 7 (a and b) that the sex differences in the white population are mostly small, especially in New York and Pennsylvania. These rates, derived from large numbers of white children, are more stable and also show no great deviation from the group average. It is only in New Jersey that the variations are higher. The number of white children in New Jersey, though not so large as in New York and Pennsylvania, is certainly large enough for computing age and sex specific death rates. In all three age groups, 5–9, 10–14, and 15–19 years, the New Jersey boys turn out to have the lowest mortality rates for heart diseases among the three Middle Atlantic States, while the girls almost as consistently show the highest rates. This discrepancy, naturally, causes a high sex difference unfavorable to the New Jersey girls, which even reaches strict statistical significance in the age group 15–19 years. The differences in mortality of the New Jersey boys and girls is more meaningful because it has the same direction in all three age groups. The values of the differences are as follows (the values of the rates for boys and girls may be seen from table 7a):

Sex differences for mortality from diseases of the heart (all forms)
New Jersey, 1939–41: White children

5–9 years	10–14 years	15–19 years
2.3±1.89	5.4±2.28	7.5±2.53

The values of the sex differences increase with age, and so does their statistical significance. As a consequence of this consistent behavior of the sexes in New Jersey, in all three age groups the

Table 7a.—Mortality from acute rheumatic fever, chronic rheumatic diseases of the heart, and diseases of the heart (all forms) in persons under 20 years, by age, race, and sex: *Middle Atlantic* and individual States, 1939–41

A. AVERAGE ANNUAL RATES PER 100,000

Area	White						Nonwhite					
	Acute rheumatic fever		Chronic rheumatic diseases of the heart		Diseases of the heart (all forms)		Acute rheumatic fever		Chronic rheumatic diseases of the heart		Diseases of the heart (all forms)	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
	Under 5 years											
Middle Atlantic	0.9	1.2	1.4	1.2	7.2	5.8	0.7	1.4	4.2	5.6	14.9	14.1
New York	.9	1.1	1.7	1.2	6.2	4.5	[1.7]	[1.7]	[5.2]	[8.4]	[8.6]	[13.5]
New Jersey	.3	1.1	.8	1.7	6.3	5.4	[0]	[0]	[7.4]	[3.7]	[22.2]	[7.4]
Pennsylvania	1.2	1.3	1.1	1.1	8.7	7.4	[0]	[1.8]	[1.8]	[3.6]	[17.9]	[18.0]
	5–9 years											
Middle Atlantic	2.7	3.4	4.7	5.1	7.1	7.4	6.5	5.7	14.3	14.7	22.1	19.8
New York	2.7	3.4	5.1	5.2	7.2	6.6	[6.2]	[7.6]	[20.1]	[15.3]	[26.2]	[15.3]
New Jersey	4.3	3.1	4.3	4.9	5.8	8.1	[10.3]	[10.0]	[10.3]	[16.7]	[27.6]	[30.0]
Pennsylvania	2.3	3.5	4.5	5.1	7.4	8.2	[5.0]	[1.6]	[10.0]	[13.1]	[14.9]	[19.6]
	10–14 years											
Middle Atlantic	3.2	3.1	9.0	9.6	12.0	13.5	7.2	7.5	17.5	20.9	22.3	27.9
New York	2.9	3.1	10.9	10.2	13.2	13.3	[4.4]	[6.9]	[23.2]	[29.0]	[23.2]	[33.2]
New Jersey	3.5	3.0	7.1	11.1	9.6	15.0	[3.1]	[0]	[12.6]	[21.5]	[28.3]	[33.7]
Pennsylvania	3.5	3.1	7.4	8.5	11.4	13.3	[12.3]	[11.9]	[13.8]	[11.9]	[18.4]	[19.3]
	15–19 years											
Middle Atlantic	2.2	2.0	11.9	10.3	18.0	16.7	3.2	6.5	16.8	20.5	23.9	29.3
New York	1.5	2.0	13.8	11.2	18.5	15.0	[1.6]	[5.4]	[21.8]	[29.7]	[24.9]	[36.5]
New Jersey	3.0	3.2	8.2	11.7	13.3	20.8	[6.6]	[9.3]	[16.6]	[9.3]	[26.5]	[24.9]
Pennsylvania	2.7	1.7	11.1	8.7	19.3	17.0	[3.3]	[6.2]	[11.6]	[15.6]	[21.6]	[23.3]

NOTE.—Rates are bracketed when based on a population group at risk less than 100,000 in the 3 years under observation.

Table 7b.—Mortality from acute rheumatic fever, chronic rheumatic diseases of the heart, and diseases of the heart (all forms) in persons under 20 years, by age, race, and sex: *Middle Atlantic* and individual States, 1939–41

B. ABSOLUTE NUMBER OF DEATHS IN 3 YEARS

Area	White						Nonwhite					
	Acute rheumatic fever		Chronic rheumatic diseases of the heart		Diseases of the heart (all forms)		Acute rheumatic fever		Chronic rheumatic diseases of the heart		Diseases of the heart (all forms)	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
	Under 5 years											
Middle Atlantic	25	30	36	31	190	146	1	2	6	8	21	20
New York	11	13	21	14	76	52	1	1	3	5	5	8
New Jersey	1	4	3	6	23	19	------	------	2	1	6	2
Pennsylvania	13	13	12	11	91	75	------	1	1	2	10	10
	5–9 years											
Middle Atlantic	77	92	133	138	199	201	10	9	22	23	34	31
New York	35	43	67	65	94	83	4	5	13	10	17	10
New Jersey	17	12	17	19	23	31	3	3	3	5	8	9
Pennsylvania	25	37	49	54	82	87	3	1	6	8	9	12
	10–14 years											
Middle Atlantic	107	99	297	310	397	436	12	13	29	36	37	48
New York	44	46	166	150	201	196	3	5	16	21	16	24
New Jersey	17	14	34	52	46	70	1	------	4	7	9	11
Pennsylvania	46	39	97	108	150	170	8	8	9	8	12	13
	15–19 years											
Middle Atlantic	78	72	424	362	640	587	5	11	26	35	37	50
New York	25	32	225	180	301	242	1	4	14	22	16	27
New Jersey	16	17	44	62	71	110	2	3	5	3	8	8
Pennsylvania	37	23	155	120	268	235	2	4	7	10	13	15

Table 8.—Population under 20 years, by age, race, and sex: *Middle Atlantic* and individual States, Census of 1940

Area	White		Nonwhite		White		Nonwhite	
	Male	Female	Male	Female	Male	Female	Male	Female
	Under 5 years				5–9 years			
Middle Atlantic	879, 909	843, 898	47, 071	47, 235	934, 192	900, 916	51, 345	52, 184
New York	407, 617	389, 037	19, 405	19, 725	434, 451	417, 241	21, 611	21, 799
New Jersey	121, 822	116, 419	9, 007	9, 016	132, 743	128, 315	9, 666	9, 998
Pennsylvania	350, 470	338, 442	18, 659	18, 494	366, 998	355, 360	20, 068	20, 387
	10–14 years				15–19 years			
Middle Atlantic	1, 104, 310	1, 073, 889	55, 266	57, 429	1, 183, 667	1, 174, 516	51, 559	56, 796
New York	506, 984	492, 369	22, 952	24, 105	541, 517	536, 708	21, 445	24, 666
New Jersey	160, 496	155, 799	10, 605	10, 876	178, 180	176, 179	10, 049	10, 704
Pennsylvania	436, 830	425, 721	21, 709	22, 448	463, 970	461, 629	20, 065	21, 426

boys show lower death rates than the group average of the Middle Atlantic division, and the girls higher. This consistently opposite deviation from the total division approaches statistical significance in the 15–19 year old boys and girls, as the following tabulation makes evident:

Differences for mortality from diseases of the heart (all forms) between Middle Atlantic and New Jersey, 1939–41: White children

	5–9 years	10–14 years	15–19 years
Male	+1.3±1.23	+2.4±1.46	+4.7±1.69
Female	−.7±1.28	−1.5±1.58	−4.1±1.64

Why the white boys exhibit a more favorable mortality from rheumatic heart diseases in New Jersey than in New York and Pennsylvania while the white girls in New Jersey have the most unfavorable rates among the three States cannot be easily explained. Local public health work in collaboration with clinical and further statistical research may be able to account for this consistent pattern of difference in mortality between boys and girls in New Jersey.

East North Central States

Tables 9 (a and b) and 10 show the death rates per 100,000, the deaths, and the population groups, in the five States of the East North Central geographic division: Ohio, Indiana, Illinois, Michigan, Wisconsin. It will be noticed immediately that for the division as a whole, and in most instances for the individual States, the mortality rates of the nonwhite children are higher than those of the white children in all age groups. However, in the individual States the rates for the nonwhite group cannot be taken alone as a reliable index of mortality because of the small population numbers exposed to risk. For the total division, the nonwhite girls show a higher mortality from heart diseases than the nonwhite boys in all age groups. This sex difference is significant in a statistical sense in the age group 10–14 years (16.4±5.39), but not in the age groups 5–9 and 15–19 years. But even here they are consistent in direction. This is not the case in the individual States, though the tendency to higher mortality for the girls is visible. The States of Illinois and Ohio together include the largest part of the nonwhite population in this division, and yet even the high differences between male and female rates for heart disease for the nonwhite children 10–14 and 15–19 years in these States are not definitely beyond strict limits of chance. In Illinois the sex differences in the nonwhite group are 22.3±10.07 for the 10–14 year olds and 23.2 ±11.35 for the 15–19, while in Ohio they are much smaller and insignificant.

It is evident from table 9 (a and b) that the white children in the individual States show only small variations in mortality from rheumatic fever diseases; their rates are all based on large population numbers. One remarkable exception occurs in the State of Indiana where we find a feature similar to that observed for New Jersey in the Middle Atlantic division. The Indiana boys, at least in the two age groups 10–14 and 15–19, show the lowest death rates for diseases of the heart among the five States, while the girls have the highest. The differences between sex groups are accordingly high in Indiana for the two age groups (4.8±2.21 and 4.4±2.25). Yet all other sex differences, as well as the deviations of the individual States from the group average, are small. Only the largest difference, that between the rate for total East North Central and the rate for Indiana for the 15–19 year old boys (+3.8 ±1.56) approaches statistical significance. The opposite deviations of the Indiana white boys and girls from the group average (also indicated in the nonwhite group) are consistent, as illustrated in the following summary which shows the lower mortality of the boys (+ sign) and the higher mortality of the girls (−sign):

Differences for mortality from diseases of the heart (all forms) between East North Central and Indiana, 1939–41; White children

	10–14 years	15–19 years
Male	+1.2±1.36	+3.8±1.56
Female	−2.6±1.46	−1.5±1.54

It might also be recalled here that, disregarding the age group under 5, mortality from rheumatic fever and heart diseases in the East North Central division as a whole is above the average for the total United States. (See appendix table 1.)

Table 9a.—Mortality from acute rheumatic fever, chronic rheumatic diseases of the heart, and diseases of the heart (all forms) in persons under 20 years, by age, race, and sex: *East North Central* and individual States, 1939–41

A. AVERAGE ANNUAL RATES PER 100,000

Area	White						Nonwhite					
	Acute rheumatic fever		Chronic rheumatic diseases of the heart		Diseases of the heart (all forms)		Acute rheumatic fever		Chronic rheumatic diseases of the heart		Diseases of the heart (all forms)	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Under 5 years												
East North Central	0.5	0.7	0.6	0.6	5.6	5.5	4.9	4.0	4.0	4.8	8.1	9.6
Ohio	.5	.7	.1	.4	3.8	4.1	[2.6]	[2.5]	[2.6]	[0]	[7.9]	[0]
Indiana	.5	.5	1.3	.8	7.8	5.8	[7.4]	[7.5]	[0]	[7.5]	[7.4]	[14.9]
Illinois	.6	.7	1.0	1.2	7.2	7.5	[9.5]	[4.7]	[2.4]	[0]	[4.7]	[7.1]
Michigan	.3	.7	.5	.2	5.2	5.9	[0]	[4.0]	[11.7]	[15.9]	[11.7]	[19.9]
Wisconsin	.8	.8	.3	.3	4.2	3.3	[0]	[0]	[0]	[24.3]	[24.8]	[48.6]
5–9 years												
East North Central	2.7	2.6	3.2	3.6	6.1	6.3	7.8	9.3	6.2	8.5	9.4	13.1
Ohio	2.5	3.3	2.5	2.3	6.0	5.7	[2.5]	[9.8]	[9.8]	[9.8]	[12.3]	[14.7]
Indiana	3.9	2.4	3.9	4.8	8.1	8.1	[7.3]	[27.6]	[7.3]	[6.9]	[14.6]	[6.9]
Illinois	2.9	2.5	3.4	3.1	7.0	6.2	[13.7]	[9.0]	[4.6]	[4.5]	[6.8]	[11.3]
Michigan	2.6	1.9	3.6	4.9	5.2	6.8	[7.7]	[0]	[3.8]	[15.3]	[7.7]	[19.1]
Wisconsin	1.3	3.0	2.3	3.8	3.7	5.4	[0]	[0]	[0]	[0]	[0]	[0]
10–14 years												
East North Central	2.3	3.3	5.0	6.2	9.1	10.1	5.8	3.5	7.3	18.2	12.3	28.7
Ohio	2.6	3.0	5.2	5.1	9.3	9.1	[4.4]	[2.1]	[2.2]	[12.8]	[4.4]	[17.1]
Indiana	3.5	4.6	3.5	7.9	7.9	12.7	[6.4]	[12.5]	[6.4]	[12.5]	[6.4]	[37.6]
Illinois	2.1	3.2	5.4	7.0	10.0	11.4	[4.3]	[2.1]	[6.5]	[20.8]	[13.0]	[35.3]
Michigan	1.6	2.6	4.3	6.3	7.9	8.7	[7.4]	[3.5]	[18.5]	[17.7]	[29.6]	[24.8]
Wisconsin	1.9	4.0	6.2	5.0	10.3	9.0	[27.8]	[0]	[0]	[82.8]	[0]	[82.8]
15–19 years												
East North Central	1.4	1.4	6.3	5.5	13.0	12.1	5.3	3.5	12.1	14.7	18.9	25.9
Ohio	1.7	1.1	6.8	6.4	15.3	12.4	[2.3]	[2.1]	[13.7]	[12.7]	[20.5]	[21.1]
Indiana	1.5	1.6	4.4	4.9	9.2	13.6	[0]	[6.1]	[6.4]	[12.2]	[12.7]	[24.4]
Illinois	1.0	1.5	7.3	5.6	14.1	12.8	[13.8]	[4.2]	[9.2]	[25.0]	[18.4]	[41.6]
Michigan	1.4	1.0	6.6	4.4	12.2	10.2	[0]	[3.7]	[19.6]	[3.7]	[23.5]	[11.1]
Wisconsin	1.4	2.6	4.9	5.7	11.4	11.7	[0]	[0]	[0]	[0]	[0]	[0]

NOTE.—Rates are bracketed when based on a population group less than 100,000 in the 3 years under observation.

Table 9b.—Mortality from acute rheumatic fever, chronic rheumatic diseases of the heart, and diseases of the heart (all forms) in persons under 20 years, by age, race, and sex: *East North Central* and individual States, 1939–41

B. ABSOLUTE NUMBER OF DEATHS IN 3 YEARS

Area	White						Nonwhite					
	Acute rheumatic fever		Chronic rheumatic diseases of the heart		Diseases of the heart (all forms)		Acute rheumatic fever		Chronic rheumatic diseases of the heart		Diseases of the heart (all forms)	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
	Under 5 years											
East North Central	16	19	18	17	165	156	6	5	5	6	10	12
Ohio	4	5	1	3	28	29	1	1	1	------	3	------
Indiana	2	2	5	3	31	22	1	1	------	1	1	2
Illinois	5	5	8	9	57	57	4	2	1	------	2	3
Michigan	2	4	3	1	33	36	------	1	3	4	3	5
Wisconsin	3	3	1	1	16	12	------	------	------	1	1	2
	5–9 years											
East North Central	77	73	91	100	175	176	10	12	8	11	12	17
Ohio	18	23	18	16	43	39	1	4	4	4	5	6
Indiana	15	9	15	18	31	30	1	4	1	1	2	1
Illinois	23	19	27	23	55	47	6	4	2	2	3	5
Michigan	16	11	22	29	32	40	2	------	1	4	2	5
Wisconsin	5	11	9	14	14	20	------	------	------	------	------	----
	10–14 years											
East North Central	75	104	161	196	297	318	8	5	10	26	17	41
Ohio	22	24	43	41	77	73	2	1	1	6	2	8
Indiana	15	19	15	33	34	53	1	2	1	2	1	6
Illinois	19	28	48	61	89	99	2	1	3	10	6	17
Michigan	11	17	29	41	54	57	2	1	5	5	8	7
Wisconsin	8	16	26	20	43	36	1	------	------	3	------	3
	15–19 years											
East North Central	48	49	219	187	450	412	7	5	16	21	25	37
Ohio	15	10	61	57	137	110	1	1	6	6	9	10
Indiana	7	7	20	22	42	61	------	1	1	2	2	4
Illinois	10	14	71	54	137	122	6	2	4	12	8	20
Michigan	10	7	46	30	85	70	------	1	5	1	6	3
Wisconsin	6	11	21	24	49	49	------	------	------	------	------	------

Table 10.—Population under 20 years by age, race, and sex: *East North Central* and individual States, Census of 1940

Area	White		Nonwhite		White		Nonwhite	
	Male	Female	Male	Female	Male	Female	Male	Female
	Under 5 years				5–9 years			
East North Central	981, 694	943, 621	41, 186	41, 476	960, 745	924, 892	42, 707	43, 193
Ohio	241, 981	236, 528	12, 697	13, 110	238, 470	229, 724	13, 562	13, 610
Indiana	132, 332	127, 210	4, 525	4, 468	127, 882	124, 092	4, 551	4, 827
Illinois	264, 238	254, 522	14, 055	14, 147	262, 350	251, 061	14, 612	14, 736
Michigan	212, 100	202, 341	8, 563	8, 380	204, 242	197, 186	8, 686	8, 741
Wisconsin	128, 043	123, 020	1, 346	1, 371	127, 801	122, 829	1, 296	1, 279
	10–14 years				15–19 years			
East North Central	1, 084, 085	1, 048, 609	45, 960	47, 629	1, 149, 861	1, 132, 506	44, 070	47, 568
Ohio	276, 990	268, 432	15, 125	15, 631	298, 813	296, 835	14, 643	15, 781
Indiana	143, 344	138, 776	5, 220	5, 321	152, 095	149, 097	5, 246	5, 474
Illinois	297, 634	289, 199	15, 397	16, 050	323, 721	318, 745	14, 515	16, 015
Michigan	226, 837	218, 641	9, 020	9, 419	232, 192	228. 474	8, 523	9, 031
Wisconsin	139, 280	133, 561	1, 198	1, 208	143, 040	139, 355	1, 143	1, 267

West North Central States

The next geographic division, West North Central, comprises the more agricultural States: Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, and Kansas. This area is not very densely populated and in some of these States (North Dakota and South Dakota) even the population of the white children does not reach the level of 100,000 observation years in the single age groups under examination. The nonwhite population is extremely small in most of these States and does not reach this level even for the total division, as will be seen from table 12 which shows the population by age, race, and sex. The death rates and the deaths are given separately in table 11 (a and b) for acute rheumatic fever, chronic rheumatic diseases of the heart, and diseases of the heart (all forms. Death rates for rheumatic heart diseases in the West North Central division as a whole are somewhat below the average for the total United States and the northeast section of the country in particular.

Disregarding for the time the bracketed rates in North and South Dakota, which, however, do not vary too much from the group average, we will again concentrate on mortality from heart diseases. In general, sex variations and State-to-State variations can be explained by chance. The sex differences are not in the same direction and not significant for the different age groups in the total division nor, of course, in the single States. In Minnesota, for instance, the boys 5–9 years old have a lower rate (2.4) than the girls (4.7); in Nebraska it is the other way, with more unfavorable rates for the boys (6.1) than for the girls (3.2). Both these differences, moreover, can be explained by chance. The largest sex difference in the 5–9 year group is 4.5 ± 2.01 and it occurs in Kansas (male 1.9, female 6.4). This approaches statistical significance and shows a higher mortality from heart diseases for the girls, which is also true for the total division. But the deviations in Kansas from the division's average mortality, for boys as well as for girls, are not significant, nor are they in any other State.

The sex differences in the next age groups, 10–14 and 15–19 years, run in the opposite direction, meaning a lower mortality from heart diseases for the girls; yet none of these sex differences in the total division or the individual States are significant, nor are the various deviations in the States from the average mortality rates in the division striking.

Altogether it may be said that the irregularity of the rates within the States and the inconsistency of the sex differences, as well as of the deviations from the group average, make it evident that in rheumatic fever mortality in the West North Central States such differences as are found

can be explained by chance. The race differential cannot be stated exactly due to the small number of nonwhite children in the single States, but a certain tendency to higher mortality among the nonwhites may be inferred from the group averages of the divisions.

Table 11a.—Mortality from acute rheumatic fever, chronic rheumatic diseases of the heart, and diseases of the heart (all forms) in persons under 20 years, by age, race, and sex: *West North Central* and individual States, 1939–41

A. AVERAGE ANNUAL RATES PER 100,000

Area	White						Nonwhite					
	Acute rheumatic fever		Chronic rheumatic diseases of the heart		Diseases of the heart (all forms)		Acute rheumatic fever		Chronic rheumatic diseases of the heart		Diseases of the heart (all forms)	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
	Under 5 Years											
West North Central	0.7	1.0	0.7	0.9	6.0	5.1	[0]	[0]	[4.0]	[2.0]	[10.0	[12.0]
Minnesota	.6	1.5	.6	.6	3.7	2.7						
Iowa	1.0	1.3	1.0	1.0	8.2	4.6						
Missouri	1.0	.8	1.0	1.0	6.8	6.2						
North Dakota	[1.1]	[0]	[0]	[1.1]	[4.4]	[3.4]						
South Dakota	[0]	[0]	[0]	[1.2]	[1.2]	[7.4]						
Nebraska	.6	1.3	0	1.3	7.6	7.9						
Kansas	.5	.5	1.0	.5	6.3	5.1						
	5–9 Years											
West North Central	1.6	1.7	1.9	2.5	4.1	5.2	[0]	[7.8]	[11.9]	[11.6]	[15.9]	[11.6]
Minnesota	1.8	1.9	.9	2.5	2.4	4.7						
Iowa	2.3	1.4	2.6	3.8	5.0	6.5						
Missouri	1.2	1.5	2.2	2.5	4.6	4.8						
North Dakota	[0]	[3.3]	[3.2]	[5.6]	[6.5]	[7.8]						
South Dakota	[3.6]	[1.2]	[1.2]	[0]	[3.6]	[3.7]						
Nebraska	2.4	1.3	2.4	1.3	6.1	3.2						
Kansas	.5	2.0	.9	1.0	1.9	6.4						
	10–14 Years											
West North Central	2.0	2.3	4.1	4.3	8.3	7.3	[3.8]	[1.9]	[11.4]	[7.6]	[11.4]	[11.4]
Minnesota	2.5	2.9	4.4	3.7	8.3	6.0						
Iowa	2.7	2.5	6.1	6.0	10.0	9.8						
Missouri	1.8	1.6	4.0	4.8	8.9	8.0						
North Dakota	[3.0]	[4.1]	[3.0]	[3.1]	[6.1]	[5.2]						
South Dakota	[1.1]	[2.3]	[3.3]	[6.9]	[6.6]	[9.2]						
Nebraska	1.7	1.2	1.7	2.3	7.3	4.1						
Kansas	.9	2.2	3.5	3.1	7.3	6.7						
	15–19 years											
West North Central	1.8	1.2	3.8	4.1	9.7	8.5	[0]	[1.9]	[2.0]	[15.1]	[6.0]	[24.5]
Minnesota	2.3	.8	5.7	7.1	10.6	11.3						
Iowa	2.0	1.2	2.6	4.7	6.6	7.9						
Missouri	1.5	1.3	5.3	2.5	10.3	7.8						
North Dakota	[1.0]	[3.1]	[0]	[4.1]	[8.1]	[6.2]						
South Dakota	[4.2]	[1.1]	[1.1]	[4.4]	[11.6]	[13.1]						
Nebraska	2.1	2.2	4.8	3.3	14.4	6.6						
Kansas	.8	.4	1.6	2.1	8.1	6.6						

Table 11b.—Mortality from acute rheumatic fever, chronic rheumatic diseases of the heart, and diseases of the heart (all forms) in persons under 20 years, by age, race, and sex: *West North Central* and individual States, 1939–41

B. ABSOLUTE NUMBER OF DEATHS IN 3 YEARS

Area	White						Nonwhite					
	Acute rheumatic fever		Chronic rheumatic diseases of the heart		Diseases of the heart (all forms)		Acute rheumatic fever		Chronic rheumatic diseases of the heart		Diseases of the heart (all forms)	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
	Under 5 years											
West North Central	12	15	11	14	96	78	------	------	2	1	5	6
Minnesota	2	5	2	2	13	9	------	------	------	------	1	------
Iowa	3	4	3	3	26	14	------	------	1	------	1	------
Missouri	4	3	4	4	27	24	------	------	1	1	2	4
North Dakota	1	------	------	1	4	3	------	------	------	------	1	------
South Dakota	------	------	------	1	1	6	------	------	------	------	------	1
Nebraska	1	2	------	2	12	12	------	------	------	------	------	------
Kansas	1	1	2	1	13	10	------	------	------	------	------	1
	5–9 years											
West North Central	26	26	30	38	65	81	------	4	6	6	8	6
Minnesota	6	6	3	8	8	15	------	1	------	------	1	------
Iowa	7	4	8	11	15	19	------	1	------	1	------	1
Missouri	5	6	9	10	19	19	------	1	5	2	6	2
North Dakota	------	3	3	5	6	7	------	------	------	1	------	1
South Dakota	3	1	1	------	3	3	------	------	------	------	------	------
Nebraska	4	2	4	2	10	5	------	------	------	------	------	------
Kansas	1	4	2	2	4	13	------	1	1	2	1	2
	10–14 years											
West North Central	35	38	71	73	145	122	2	1	6	4	6	6
Minnesota	9	10	16	13	30	21	1	------	2	------	2	------
Iowa	9	8	20	19	33	31	------	------	------	------	------	------
Missouri	8	7	18	21	40	35	------	1	3	4	3	5
North Dakota	3	4	3	3	6	5	------	------	1	------	1	------
South Dakota	1	2	3	6	6	8	------	------	------	------	------	------
Nebraska	3	2	3	4	13	7	------	------	------	------	------	------
Kansas	2	5	8	7	17	15	1	------	------	------	------	1
	15–19 years											
West North Central	34	22	70	74	179	153	------	1	1	8	3	13
Minnesota	9	3	22	27	41	43	------	------	------	------	------	------
Iowa	7	4	9	16	23	27	------	------	------	------	------	------
Missouri	7	6	25	12	49	37	------	1	1	7	1	10
North Dakota	1	3	------	4	8	6	------	------	------	------	1	------
South Dakota	4	1	1	4	11	12	------	------	------	------	------	------
Nebraska	4	4	9	6	27	12	------	------	------	------	------	1
Kansas	2	1	4	5	20	16	------	------	------	1	1	2

NOTE.—Rates are bracketed when based on a population group less than 100,000 in the 3 years under observation. Whenever this was the case for the total geographic division, rates are not shown at all for individual States therein.

Table 12.—Population under 20 years by age, race, and sex: *West North Central* and individual States, Census of 1940

Area	White		Nonwhite		White		Nonwhite	
	Male	Female	Male	Female	Male	Female	Male	Female
	Under 5 years				5–9 years			
West North Central	533, 651	512, 156	16, 715	16, 635	533, 974	514, 978	16, 801	17, 188
Minnesota	116, 575	110, 878	1, 299	1, 305	111, 250	106, 544	1, 177	1, 205
Iowa	105, 054	100, 670	736	657	100, 836	97, 630	671	720
Missouri	132, 943	128, 410	9, 060	9, 058	137, 935	133, 217	9, 339	9, 497
North Dakota	30, 530	29, 612	816	835	30, 983	29, 985	703	751
South Dakota	27, 452	26, 979	1, 700	1, 732	28, 078	27, 391	1, 524	1, 538
Nebraska	52, 782	50, 328	729	707	54, 502	52, 419	766	865
Kansas	68, 315	65, 279	2, 375	2, 341	70, 390	67, 792	2, 621	2, 612
	10–14 years				15–19 years			
West North Central	580, 686	560, 772	17, 534	17, 569	612, 653	602, 011	16, 778	17, 709
Minnesota	120, 534	116, 020	1, 234	1, 130	128, 603	126, 636	1, 075	1, 035
Iowa	109, 682	105, 727	703	764	116, 427	114, 069	739	751
Missouri	150, 553	146, 004	9, 800	9, 827	158, 436	157, 150	9, 424	10, 150
North Dakota	32, 791	32, 245	664	675	32, 756	32, 151	584	558
South Dakota	30, 267	28, 924	1, 436	1, 408	31, 514	30, 600	1, 297	1, 305
Nebraska	59, 571	57, 160	827	875	62, 534	60, 963	770	834
Kansas	77, 288	74, 692	2, 870	2, 890	82, 383	80, 442	2, 889	3, 076

South Atlantic States

The South Atlantic division comprises eight States: Delaware, Maryland, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida, and the District of Columbia. These States are very different in their socio-economic structure: Delaware, Maryland, and West Virginia, bordering the Middle Atlantic group, represent more industrialized areas; the District of Columbia has the characteristics of a metropolitan city; while Virginia, North Carolina, South Carolina, Georgia, and Florida are predominantly agricultural States, Florida having also the characteristics of a resort State. But they are all marked by a more or less high proportion of Negro population, except West Virginia where the percentage is not much above 5. The death rates and deaths from acute rheumatic fever, chronic rheumatic diseases of the heart, and diseases of the heart (all forms) by age, race, and sex are shown separately in table 13 (a and b), and the population in table 14. In the small State of Delaware and in the District of Columbia, the white population does not reach the level of 100,000 for 3 years of exposure, in the single age-sex groups; for the nonwhite population (almost entirely Negro) this is the case also in Maryland, West Virginia, and Florida. The rates for those groups are again shown in brackets.

The large nonwhite population of the division as a whole, however, offers a good opportunity for comparing the two race groups on a sound population basis. On the average, the mortality from heart diseases of the nonwhite children is almost twice that of the white (see the detailed ratios in table 4); the death rates of the nonwhite are higher in all age groups. It will be recalled (see tables V and VII) that in the South Atlantic the death rates for the white children are as a rule significantly below those in the total United States; for the nonwhite children they are about the same or show no significant deviation from the United States average.

We may summarize the manifold findings, according to age, as follows. There are no significant sex differences in the age group 5–9 years. The death rates for diseases of the heart (all forms) in the total division are 4.9 and 5.0 for white boys and girls, respectively, and 9.1 and 9.0 for the nonwhite. In the individual States the respective deviations from these group averages are not very great, if we discount the bracketed values which necessarily show a higher chance fluctuation. The highest sex difference for the white children occurs in Maryland, 3.7 ± 2.38; for the nonwhite in South Carolina, 3.7 ± 3.52. Both differences, in favor of the boys, happen to

Table 13a.—Mortality from acute rheumatic fever, chronic rheumatic diseases of the heart, and diseases of the heart (all forms) in persons under 20 years, by age, race, and sex: *South Atlantic* and individual States, 1939–41

A. AVERAGE ANNUAL RATES PER 100,000

Area	White						Nonwhite					
	Acute rheumatic fever		Chronic rheumatic diseases of the heart		Diseases of the heart (all forms)		Acute rheumatic fever		Chronic rheumatic diseases of the heart		Diseases of the heart (all forms)	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Under 5 years												
South Atlantic	0.8	0.5	0.8	0.8	7.1	6.5	0.9	1.5	0.8	1.6	10.0	10.2
Delaware	[7.8]	[0]	[0]	[0]	[0]	[0]	[23.0]	[0]	[0]	[0]	[0]	[0]
Maryland	1.2	0.6	0	1.9	3.5	5.6	[0]	[0]	[0]	[2.5]	[12.7]	[12.6]
District of Columbia	[0]	[0]	[0]	[2.6]	[0]	[7.9]	[4.6]	[4.7]	[0]	[0]	[18.6]	[9.4]
Virginia	.7	.4	1.5	.8	5.1	6.8	[2.1]	[1.0]	[0]	[2.0]	[6.2]	[12.3]
West Virginia	.4	.7	.7	0	7.4	5.8	[0]	[0]	[0]	[0]	[0]	[0]
North Carolina	.5	0	.8	.8	11.9	7.6	1.1	2.8	1.1	.6	14.3	10.8
South Carolina	1.8	1.3	1.2	1.9	4.3	7.5	0	1.9	1.9	3.9	13.0	11.6
Georgia	.7	.7	.7	.3	4.1	7.0	0	0	0	1.1	4.5	10.0
Florida	.6	0	1.2	.6	13.4	4.4	[1.5]	[1.5]	[1.5]	[0]	[10.8]	[4.4]
5–9 years												
South Atlantic	2.1	2.2	2.3	2.5	4.9	5.0	2.1	3.9	3.9	4.2	9.1	9.0
Delaware	[0]	[0]	[3.9]	[4.1]	[3.9]	[4.1]	[44.1]	[0]	[0]	[0]	[0]	[22.3]
Maryland	4.1	2.4	1.7	4.8	2.9	6.6	[4.8]	[7.0]	[9.6]	[7.0]	[24.0]	[11.7]
District of Columbia	[2.8]	[5.7]	[8.5]	[2.9]	[8.5]	[2.9]	[0]	[14.3]	[4.8]	[14.3]	[14.5]	[14.3]
Virginia	3.2	4.4	2.9	2.2	5.0	4.8	1.0	3.8	5.8	1.9	9.6	7.7
West Virginia	2.5	1.5	1.4	3.0	4.7	6.7	[0]	[0]	[0]	[18.3]	[0]	[18.3]
North Carolina	1.5	1.5	2.5	2.0	6.2	4.3	1.7	3.3	4.5	3.9	9.1	7.8
South Carolina	1.8	1.8	2.4	2.4	4.2	3.7	1.3	3.2	3.9	4.5	7.8	11.5
Georgia	2.0	1.7	2.0	1.7	5.3	4.8	2.2	2.2	2.2	3.8	9.3	8.1
Florida	0	1.9	1.8	1.9	3.7	5.1	[3.0]	[7.2]	[1.5]	[1.4]	[3.0]	[4.3
10–14 years												
South Atlantic	2.2	2.3	3.1	4.0	6.4	6.7	4.9	4.7	4.6	5.3	10.6	12.4
Delaware	[3.7]	[7.3]	[7.3]	[0]	[11.0]	[11.0]	[20.6]	[21.6]	[0]	[0]	[61.9]	[0]
Maryland	1.0	1.6	6.7	6.4	8.3	8.0	[4.6]	[4.5]	[13.7]	[4.5]	[18.3]	[6.7]
District of Columbia	[7.4]	[5.0]	[7.4]	[12.4]	[12.3]	[14.9]	[4.8]	[9.4]	[9.5]	[23.5]	[9.5]	[42.3]
Virginia	2.0	1.7	2.3	3.8	4.7	5.9	7.2	7.2	1.8	6.3	5.4	11.7
West Virginia	3.1	1.7	4.1	5.2	6.4	7.0	[5.6]	[0]	[5.6]	[5.3]	[5.6]	[5.3]
North Carolina	1.6	3.2	3.3	5.3	7.5	8.7	4.4	6.6	5.0	6.6	11.1	10.4
South Carolina	3.4	3.0	.6	2.4	5.1	4.8	5.2	4.6	3.3	3.3	11.1	16.4
Georgia	2.2	1.7	2.2	2.0	6.1	4.3	3.9	1.7	4.5	4.4	10.6	11.0
Florida	1.6	1.7	1.1	.6	4.3	4.4	[2.8]	[2.7]	[4.2]	[2.7]	[9.7]	[10.9]
15–19 years												
South Atlantic	1.5	1.5	4.5	4.4	9.6	8.5	2.4	1.5	5.0	6.0	15.1	22.7
Delaware	[0]	[0]	[6.6]	[23.7]	[16.5]	[33.8]	[0]	[0]	[20.0]	[0]	[20.0]	[40.4]
Maryland	3.3	2.9	8.0	8.3	10.8	13.2	[4.7]	[0]	[11.8]	[11.2]	[21.2]	[22.4]
District of Columbia	[2.0]	[0]	[6.0]	[2.0]	[8.0]	[9.8]	[4.8]	[0]	[4.8]	[8.3]	[24.2]	[24.8]
Virginia	1.6	3.0	3.5	5.6	8.8	8.9	1.8	1.8	5.3	1.8	8.9	18.7
West Virginia	.7	1.0	4.1	5.9	11.0	9.0	[5.9]	[0]	[11.8]	[10.9]	[29.5]	[38.0]
North Carolina	.9	.9	5.0	3.0	9.7	8.9	3.3	.5	3.9	5.4	15.0	20.6
South Carolina	2.2	2.8	0	3.3	8.2	7.7	1.3	3.2	4.7	5.7	16.8	27.8
Georgia	2.2	.6	4.1	2.2	7.6	5.1	1.2	2.1	4.2	7.5	13.1	24.2
Florida	0	.5	6.1	1.1	11.1	2.7	[2.9]	[0]	[2.9]	[6.4]	[16.0]	[14.2]

NOTE.—Rates are bracketed when based on a population group less than 100,000 in 3 years under observation.

Table 13b.—Mortality from acute rheumatic fever, chronic rheumatic diseases of the heart, and diseases of the heart (all forms) in persons under 20 years, by age, race, and sex: *South Atlantic* and individual States, 1939–41

B. ABSOLUTE NUMBER OF DEATHS IN 3 YEARS

Area	White						Nonwhite					
	Acute rheumatic fever		Chronic rheumatic diseases of the heart		Diseases of the heart (all forms)		Acute rheumatic fever		Chronic rheumatic diseases of the heart		Diseases of the heart (all forms)	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Under 5 years												
South Atlantic	15	8	15	14	129	114	7	11	6	12	75	77
Delaware	2						1					
Maryland	2	1		3	6	9				1	5	5
District of Columbia				1		3	1	1			4	2
Virginia	2	1	4	2	14	18	2	1		2	6	12
West Virginia	1	2	2		21	16						
North Carolina	2		3	3	47	29	2	5	2	1	25	19
South Carolina	3	2	2	3	7	12		3	3	6	20	18
Georgia	2	2	2	1	12	20				2	8	18
Florida	1		2	1	22	7	1	1	1		7	3
5–9 years												
South Atlantic	39	39	42	44	90	89	16	30	30	33	70	70
Delaware			1	1	1	1	2					1
Maryland	7	4	3	8	5	11	2	3	4	3	10	5
District of Columbia	1	2	3	1	3	1		3	1	3	3	3
Virginia	9	12	8	6	14	13	1	4	6	2	10	8
West Virginia	7	4	4	8	13	18				3		3
North Carolina	6	6	10	8	25	17	3	6	8	7	16	14
South Carolina	3	3	4	4	7	6	2	5	6	7	12	18
Georgia	6	5	6	5	16	14	4	4	4	7	17	15
Florida		3	3	3	6	8	2	5	1	1	2	3
10–14 years												
South Atlantic	44	43	61	76	125	126	38	37	36	42	83	98
Delaware	1	2	2		3	3	1	1			3	
Maryland	2	3	13	12	16	15	2	2	6	2	8	3
District of Columbia	3	2	3	5	5	6	1	2	2	5	2	9
Virginia	6	5	7	11	14	17	8	8	2	7	6	13
West Virginia	9	5	12	15	19	20	1		1	1	1	1
North Carolina	7	13	14	22	32	36	8	12	9	12	20	19
South Carolina	6	5	1	4	9	8	8	7	5	5	17	25
Georgia	7	5	7	6	19	13	7	3	8	8	19	20
Florida	3	3	2	1	8	8	2	2	3	2	7	8
15–19 years												
South Atlantic	30	30	90	87	192	168	18	12	38	49	115	184
Delaware			2	7	5	10			1		1	2
Maryland	7	6	17	17	23	27	2		5	5	9	10
District of Columbia	1		3	1	4	5	1		1	2	5	6
Virginia	5	9	11	17	28	27	2	2	6	2	10	21
West Virginia	2	3	12	17	32	26	1		2	2	5	7
North Carolina	4	4	21	13	41	38	6	1	7	10	27	38
South Carolina	4	5		6	15	14	2	5	7	9	25	44
Georgia	7	2	13	7	24	16	2	4	7	14	22	45
Florida		1	11	2	20	5	2		2	5	11	11

Table 14.—Population under 20 years by age, race, and sex: *South Atlantic* and individual States, Census of 1940

Area	White		Nonwhite		White		Nonwhite	
	Male	Female	Male	Female	Male	Female	Male	Female
	Under 5 years				5–9 years			
South Atlantic	602, 747	582, 752	249, 972	252, 437	607, 902	588, 628	256, 178	259, 405
Delaware	8, 538	8, 071	1, 451	1, 418	8, 577	8, 097	1, 513	1, 495
Maryland	56, 391	53, 965	13, 101	13, 208	57, 172	55, 495	13, 873	14, 290
District of Columbia	12, 869	12, 668	7, 185	7, 129	11, 767	11, 605	6, 876	6, 997
Virginia	91, 259	87, 858	32, 308	32, 652	92, 900	90, 041	34, 733	34, 794
West Virginia	94, 295	91, 500	5, 434	5, 350	92, 124	89, 048	5, 360	5, 455
North Carolina	131, 731	127, 614	58, 093	58, 560	134, 762	130, 369	58, 892	59, 818
South Carolina	54, 574	53, 166	51, 344	51, 576	55, 909	54, 451	51, 587	52, 089
Georgia	98, 421	95, 320	59, 370	60, 011	99, 977	96, 922	60, 797	61, 360
Florida	54, 669	52, 590	21, 686	22, 533	54, 714	52, 600	22, 547	23, 107
	10–14 years				15–19 years			
South Atlantic	653, 164	630, 848	260, 847	263, 474	668, 997	661, 009	254, 432	270, 335
Delaware	9, 115	9, 082	1, 615	1, 540	10, 118	9, 857	1, 670	1, 652
Maryland	64, 431	62, 531	14, 571	14, 819	70, 781	67, 952	14, 133	14, 911
District of Columbia	13, 542	13, 456	7, 007	7, 084	16, 710	17, 042	6, 878	8, 050
Virginia	99, 958	96, 265	36, 916	37, 148	106, 251	100, 902	37, 508	37, 392
West Virginia	98, 209	95, 434	5, 913	6, 236	97, 250	96, 798	5, 645	6, 143
North Carolina	142, 918	137, 451	59, 993	61, 018	141, 390	142, 094	59, 864	61, 502
South Carolina	58, 296	55, 923	51, 083	50, 687	61, 152	60, 503	49, 678	52, 757
Georgia	104, 471	100, 444	59, 721	60, 373	105, 161	105, 052	56, 132	62, 065
Florida	62, 224	60, 262	24, 028	24, 569	60, 184	60, 809	22, 924	25, 863

be of the same magnitude (though the rate levels are different), and both can be easily explained by chance.

In the following age group, 10–14 years, the outcome is similar. The rates are somewhat higher than in the preceding age group, being for the total South Atlantic 6.4 and 6.7 for the white, and 10.6 and 12.4 for the nonwhite, boys and girls respectively. In the individual States that have populations deemed large enough, the sex differences are again small, not in the same direction, and not significant in any instance; nor are the deviations from the group average significant.

In the last age group, 15–19 years, the results differ somewhat more and show a more interesting feature. The death rates for heart diseases in the total division rise again in both race groups, to 9.6 and 8.5 for the white, and 15.1 and 22.7 for the nonwhite, boys and girls respectively. The small sex difference in the white group in favor of the girls, 1.1 ± 0.95, is not significant; but the large sex difference in the nonwhite group, 7.6 ± 2.19, runs in the opposite direction and is strictly significant. This higher mortality of the young nonwhite females is seen also in the preceding age group, and has been mentioned before occasionally in some of the other geographic divisions where, however, the basic population figures were not large enough for definite conclusions. The same tendency can be seen in the individual States. In those with more stable rates, like Virginia, North Carolina, South Carolina, Georgia, the unfavorable sex differences for the nonwhite girls are evident and approach significance.

In the white group the only significant sex difference occurs in Florida, 8.4 ± 2.76, and is in the other direction, the white boys exhibiting a much higher mortality rate for heart diseases (11.1) than the girls (2.7). An explanation for this contrast may be difficult to find, but the statistical fact may be of interest to local public health authorities. As a consequence of the very low rate for the white girls in Florida, the deviation from the division's average is likewise significant, being $+5.8 \pm 2.04$.

The death rate of the white girls is also low in Georgia (5.1) but far above average in Maryland (13.2), the latter difference from the group average amounting to -4.7 ± 1.92. Thus quite a few State-to-State variations in mortality from heart diseases occur among white girls of this age, but not among the white boys. The corresponding

deviations from average mortality among the nonwhite youth in no case reach statistical significance; not even in Virginia where the nonwhite boys have the lowest rate (8.9), or in West Virginia where they have the highest rate (29.5), among the States. In this racial group the girls show less striking variations from State to State.

The most important finding to be kept in mind, however, is the high mortality of the young nonwhite females compared with the nonwhite males and, of course, with the white females of the same age. This is a very characteristic feature in the South Atlantic States, reflecting probably the greater risk that nonwhite girls run from chronic heart diseases in combination with the hardships of pregnancies at an early age.

East South Central States

The four agricultural States of the East South Central division are Kentucky, Tennessee, Alabama, and Mississippi. Apart from Kentucky, these States have a high proportion of Negro population, especially Alabama and Mississippi. In the latter State the Negro population is half the total or more, in the various age groups. The death rates and absolute numbers of deaths from acute rheumatic fever, chronic rheumatic diseases of the heart, and diseases of the heart (all forms) are shown in table 15 (a and b) and the corresponding population by age, race, and sex in table 16.

Table 15a.—Mortality from acute rheumatic fever, chronic rheumatic diseases of the heart, and diseases of the heart (all forms) in persons under 20 years, by age, race, and sex: *East South Central* and individual States, 1939–41

A. AVERAOE ANNUAL RATES PER 100,000

Area	White						Nonwhite					
	Acute rheumatic fever		Chronic rheumatic diseases of the heart		Diseases of the heart (all forms)		Acute rheumatic fever		Chronic rheumatic diseases of the heart		Diseases of the heart (all forms)	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
	Under 5 years											
East South Central	1.3	0.5	1.7	0.6	8.1	6.9	0.5	1.3	1.1	0.9	5.7	4.7
Kentucky	.7	.3	1.7	.8	10.7	6.8	[0]	[0]	[0]	[4.2]	[17.1]	[24.9]
Tennessee	1.7	1.2	.8	0	5.6	6.4	[0]	[1.5]	[3.0]	[1.5]	[6.1]	[1.5]
Alabama	1.4	.4	2.8	.4	9.4	7.6	.6	1.8	.6	.6	4.9	4.8
Mississippi	1.8	0	1.8	1.9	4.8	7.5	.5	1.1	1.1	.5	4.8	3.2
	5–9 years											
East South Central	1.9	2.2	3.2	1.9	6.1	4.5	3.3	2.6	2.6	3.3	6.8	7.9
Kentucky	2.2	2.0	3.2	1.5	6.9	4.3	[3.8]	[11.5]	[0]	[3.8]	[7.6]	[15.4]
Tennessee	2.2	3.1	3.9	2.6	6.4	4.8	[1.4]	[5.7]	[5.7]	[5.7]	[7.2]	[10.0]
Alabama	1.4	1.8	2.4	2.9	4.5	5.4	4.1	1.2	4.1	2.3	10.0	7.0
Mississippi	1.2	1.2	3.0	0	6.5	2.4	3.2	1.6	.5	3.2	3.8	6.9
	10–14 years											
East South Central	2.2	2.2	4.6	3.6	7.8	6.6	1.7	4.2	3.9	3.3	7.9	7.4
Kentucky	2.1	1.2	5.0	3.5	7.6	8.2	[3.5]	[10.5]	[3.5]	[7.0]	[10.4]	[21.0]
Tennessee	3.7	3.3	5.1	4.7	8.8	6.1	[1.4]	[0]	[6.9]	[6.8]	[12.4]	[10.9]
Alabama	1.0	2.0	4.2	3.7	8.1	7.1	2.4	5.3	4.1	1.8	8.3	5.3
Mississippi	1.1	2.3	3.3	1.7	5.5	3.4	1.1	3.8	2.7	2.7	5.3	6.0
	15–19 years											
East South Central	1.1	1.4	4.9	3.2	10.8	7.8	1.4	1.3	4.3	6.2	14.3	20.3
Kentucky	1.2	1.2	5.3	3.4	13.5	9.5	[0]	[0]	[3.4]	[0]	[13.5]	[26.4]
Tennessee	.8	1.3	4.9	4.0	9.2	9.7	[2.8]	[0]	[11.0]	[10.3]	[23.4]	[24.6]
Alabama	1.0	2.7	4.1	3.1	9.2	6.5	1.3	2.5	5.3	6.1	18.5	19.0
Mississippi	1.7	0	5.2	1.2	10.4	1.7	1.2	1.1	.6	5.6	6.6	18.6

NOTE.—Rates are bracketed when based on a population group less than 100,000 in the 3 years under observation.

Table 15b.—Mortality from acute rheumatic fever, chronic rheumatic diseases of the heart, and diseases of the heart (all forms) in persons under 20 years by age, race, and sex: *East South Central* and individual States, 1939–41

B. ABSOLUTE NUMBER OF DEATHS IN 3 YEARS

Area	White						Nonwhite					
	Acute rheumatic fever		Chronic rheumatic diseases of the heart		Diseases of the heart (all forms)		Acute rheumatic fever		Chronic rheumatic diseases of the heart		Diseases of the heart (all forms)	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
	Under 5 years											
East South Central	16	6	21	7	99	82	2	6	5	4	25	21
Kentucky	3	1	7	3	44	27	------	------	------	1	4	6
Tennessee	6	4	3	------	20	22	------	1	2	1	4	1
Alabama	4	1	8	1	27	21	1	3	1	1	8	8
Mississippi	3	------	3	3	8	12	1	2	2	1	9	6
	5–9 years											
East South Central	23	26	39	23	75	53	15	12	12	15	31	36
Kentucky	9	8	13	6	28	17	1	3	------	1	2	4
Tennessee	8	11	14	9	23	17	1	4	4	4	5	7
Alabama	4	5	7	8	13	15	7	2	7	4	17	12
Mississippi	2	2	5	------	11	4	6	3	1	6	7	13
	10–14 years											
East South Central	28	27	59	45	100	82	8	19	18	15	36	34
Kentucky	9	5	21	14	32	33	1	3	1	2	3	6
Tennessee	14	12	19	17	33	22	1	------	5	5	9	8
Alabama	3	6	13	11	25	21	4	9	7	3	14	9
Mississippi	2	4	6	3	10	6	2	7	5	5	10	11
	15–19 years											
East South Central	14	18	61	40	135	97	6	6	18	28	60	91
Kentucky	5	5	22	14	56	39	------	------	1	------	4	8
Tennessee	3	5	18	15	34	36	2	------	8	8	17	19
Alabama	3	8	12	9	27	19	2	4	8	10	28	31
Mississippi	3	------	9	2	18	3	2	2	1	10	11	33

Table 16.—Population under 20 years, by age, race, and sex: *East South Central* and individual States, Census of 1940

Area	White		Nonwhite		White		Nonwhite	
	Male	Female	Male	Female	Male	Female	Male	Female
	Under 5 years				5–9 years			
East South Central	406, 614	393, 682	146, 746	148, 881	409, 034	396, 452	150, 969	152, 067
Kentucky	136, 843	132, 538	7, 781	8, 030	136, 171	131, 407	8, 736	8, 685
Tennessee	118, 998	115, 081	21, 944	22, 089	120, 034	117, 191	23, 257	23, 325
Alabama	95, 270	92, 391	54, 336	55, 322	96, 749	93, 400	56, 844	57, 505
Mississippi	55, 503	53, 672	62, 685	63, 440	56, 080	54, 454	62, 132	62, 552
	10–14 years				15–19 years			
East South Central	427, 448	411, 822	152, 707	152, 319	417, 493	414, 813	140, 041	149, 442
Kentucky	139, 845	134, 927	9, 570	9, 516	138, 523	136, 330	9, 872	10, 082
Tennessee	125, 204	120, 236	24, 211	24, 433	123, 142	123, 928	24, 190	25, 784
Alabama	102, 307	98, 662	56, 562	56, 810	98, 152	97, 329	50, 525	54, 285
Mississippi	60, 092	57, 997	62, 364	61, 560	57, 676	57, 226	55, 454	59, 291

It will be realized from the population table that the numbers of nonwhite children in Kentucky and Tennessee are not large enough, according to our standard, to yield stable death rates; in Tennessee the groups are closer to the level of 100,000 observation years than in Kentucky. The bracketed rates again show wider variation and inconsistency.

Ignoring the age group under 5, there is small variation from State to State in the 5–9 and 10–14 year-old children. In the former group the death rates for diseases of the heart (all forms) are 6.1 and 4.5 for the white, and 6.8 and 7.9 for the nonwhite, boys and girls respectively. Both sex differences, running in opposite directions, are insignificant, as are the sex differences in the individual States. This is true even in Mississippi where the low rate of the white girls (2.4) causes the largest sex difference in the white group (4.1 ± 2.31), and the low rate of the nonwhite boys (3.8) the largest sex difference in the nonwhite (3.1 ± 2.39). The deviations from the division's average in the single States are not significant in any instance for the white children; for the nonwhite group the deviations from the group average reach twice their standard errors only for the boys, in Alabama where the rate (10.0) is far above, and in Mississippi where the rate (3.8) is far below, average (6.8). The highest rate among the nonwhite girls occurs in Kentucky (15.4); but even this high deviation from the group average (7.9) is within normal chance limits (-7.5 ± 5.36) and again confirms the general rule that those rates (marked by brackets) are not stable enough for comparisons without considering their chance errors.

In the next age group, 10–14 years, the findings are similar. The variations from State to State are even smaller and can almost everywhere be attributed to normal chance fluctuations. Neither the sex difference nor the difference between total and subtotal reaches significance in either race group, except the large deviation of the nonwhite girls in Kentucky who show by far the highest death rate for heart diseases (21.0) in the individual States. This deviation from the group average (7.4) approaches strict statistical significance (-13.6 ± 4.92). It should also be mentioned that in Tennessee the rates for the nonwhite children are above group average, though not significantly so in a statistical sense.

The over-all picture in the oldest group, 15–19 years, differs essentially from the preceding age groups and resembles the results noticed in the South Atlantic division. Sex differences are high, though in opposite directions in the two race groups. The death rates for diseases of the heart in the total division are 10.8 and 7.8 for white males and females respectively, and 14.3 and 20.3 for the nonwhite. Both differences, 3.0 ± 1.22 in the white group and 6.0 ± 2.82 in the nonwhite, approach statistical significance and mark the higher mortality of the *white boys* and of the *nonwhite girls* in the respective racial groups. This inverse sex difference is definitely beyond chance fluctuations in the large population of Mississippi, being for both race groups more than three times the standard errors. In Mississippi, due to the extremely low mortality from heart diseases of the white girls (1.7) and nonwhite boys (6.6), the deviations of these two groups from the average death rates of the division are likewise strictly significant, the exact values being $+6.1 \pm 1.98$ for the white girls and $+7.7 \pm 2.27$ for the nonwhite boys.

Thus again, the outstanding feature in this southern division is that the nonwhite females, 15–19 years of age, suffer a definitely higher mortality than the nonwhite males and the white females of the same age. It seems reasonable to assume that this overmortality of the nonwhite girls from diseases of the heart is due to factors similar to those that cause their high mortality from tuberculosis.

There is another item worth mentioning, which parallels the findings for tuberculosis. In the two States, Kentucky and Tennessee, mortality from chronic heart diseases is higher than in the two other States, Alabama and Mississippi, in almost all age groups; this is rather consistent in the nonwhite group and visible in the white group though not so consistent. Although the rates in Kentucky and Tennessee for the nonwhite children are not based on large enough numbers, the consistency of the findings may have some significance. This observation of high mortality from heart diseases in Kentucky and Tennessee is in accord with the well-known results of tuberculosis epidemiology in the United States which has shown, over many years, the death rates in these States to be almost the highest in the country. It could be that the same environmental influences which aggravate the final outcome of tuberculosis are at work also in other chronic diseases such as rheumatic fever.

West South Central States

West South Central comprises the four States: Arkansas, Louisiana, Oklahoma, and Texas. These States have a large number, or high proportion, of nonwhite children, except Oklahoma where the percentage of nonwhite population is just below 10. It may be further mentioned that in Oklahoma the American Indians have a large reservation and form a considerable part of the nonwhite group, almost one-third. In Texas it is not so much a high percentage of nonwhite population (slightly under 15) as the large total population in this State which brings the number of the nonwhite children well above the level of 100,000 lives exposed to risk, in the single age groups, for a 3-year observation (see population in table 18). In table 17 (a and b), the death rates and the deaths are shown in the same manner as before for the three isolated causes.

In general it can be stated that in this southern section, too, the death rates (disregarding children under 5) for rheumatic fever and heart diseases are relatively low in both race groups, at least below the average of the total United States, as may be recalled from appendix table 1; this will be seen more distinctly from table VII which shows the differences between total United States and each

Table 17a.—Mortality from acute rheumatic fever, chronic rheumatic diseases of the heart, and diseases of the heart (all forms) in persons under 20 years, by age, race, and sex: *West South Central* and individual States, 1939–41

A. AVERAGE ANNUAL RATES PER 100,000

Area	White						Nonwhite					
	Acute rheumatic fever		Chronic rheumatic diseases of the heart		Diseases of the heart (all forms)		Acute rheumatic fever		Chronic rheumatic diseases of the heart		Diseases of the heart (all forms)	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
	Under 5 years											
West South Central	0.3	0.3	0.9	1.0	8.6	8.0	0.5	1.6	2.1	0.8	9.1	8.8
Arkansas	0	.5	1.3	1.4	5.4	6.9	[0]	[1.3]	[2.7]	[1.3]	[8.0]	[5.3]
Louisiana	0	.5	0	.5	5.7	3.9	.7	1.5	3.6	.7	10.1	10.2
Oklahoma	3	.3	1.0	.3	6.3	10.4	[0]	[0]	[2.9]	[2.9]	[17.6]	[14.4]
Texas	.4	.1	.9	1.4	11.4	8.5	.8	2.4	0	0	6.4	7.9
	5–9 years											
West South Central	1.5	2.3	1.8	1.6	4.3	3.4	1.3	2.1	3.4	2.8	7.0	6.2
Arkansas	.4	1.4	1.8	1.4	3.5	2.3	[0]	[1.3]	[1.3]	[0]	[3.9]	[2.6]
Louisiana	1.4	1.0	2.4	1.5	3.3	3.4	2.2	2.2	6.0	3.7	9.7	7.4
Oklahoma	1.6	3.7	1.6	1.7	4.9	4.0	[2.7]	[0]	[0]	[2.7]	[2.7]	[5.4]
Texas	1.7	2.3	1.7	1.6	4.6	3.4	.7	2.9	2.9	3.6	7.2	7.2
	10–14 years											
West South Central	1.6	1.6	2.7	3.0	5.7	6.5	2.0	2.5	6.4	4.5	11.7	10.3
Arkansas	3.8	1.7	3.4	1.7	5.9	3.1	[1.3]	[0]	[2.6]	[2.6]	[7.8]	[7.8]
Louisiana	.9	.4	1.7	4.4	3.4	8.0	3.7	3.7	8.1	6.6	12.5	12.4
Oklahoma	1.2	2.6	4.7	2.9	8.1	5.8	[0]	[0]	[10.4]	[2.6]	[15.5]	[10.3]
Texas	1.4	1.5	2.0	2.9	5.3	7.4	1.4	3.5	5.6	4.2	12.0	9.7
	15–19 years											
West South Central	1.6	0.9	3.9	2.7	9.7	7.9	1.1	2.0	4.0	3.8	13.2	16.6
Arkansas	1.7	.4	4.3	2.2	5.5	6.1	[0]	[1.3]	[5.5]	[1.3]	[15.2]	[11.7]
Louisiana	.4	0	3.0	3.5	9.6	6.1	3.2	.7	2.4	6.6	11.9	24.3
Oklahoma	1.8	1.2	5.8	4.7	9.8	8.7	[0]	[2.6]	[2.6]	[2.6]	[10.5]	[7.8]
Texas	1.7	1.1	3.3	1.8	10.8	8.5	0	3.4	5.1	2.7	13.9	14.4

Note.—Rates are bracketed when based on a population group less than 100,000 in the 3 years under observation.

geographic division as well as their statistical significance.

All the variations from State to State are not very striking. In the age group 5–9 years, there is no significant sex difference in any instance, nor a marked deviation or statistically significant deviation in any one State from the group total. The variation in the age group 10–14 years is somewhat greater; but the sex difference in mortality from diseases of the heart approaches significance only in the case of the white children in Louisiana (4.6 ± 2.24), due to a low rate for the boys (3.4) and a high rate for the girls (8.0). Even this sex difference does not mean much in view of the fact that in other States the sex difference is in the opposite direction, for instance in Arkansas and Oklahoma where there is a higher mortality from heart diseases for the boys.

In the group of adolescents, 15–19, we see the same interesting phenomenon referred to in discussing the geographical divisions of the South: the nonwhite girls exhibit a higher mortality from diseases of the heart than the boys, while the inverse is true in the white group. The sex differences for the division as a whole, however, are not significant from a strict statistical point of view; only the high mortality of the nonwhite girls in Louisiana (24.3) as compared with the boys (11.9) is especially marked, causing a difference of 12.4 ± 5.23, while the inverse difference among the whites is statistically insignificant.

Table 17b.—Mortality from acute rheumatic fever, chronic rheumatic diseases of the heart, and diseases of the heart (all forms) in persons under 20 years by age, race, and sex: *West South Central* and individual States, 1939–41

B. ABSOLUTE NUMBER OF DEATHS IN 3 YEARS

Area	White						Nonwhite					
	Acute rheumatic fever		Chronic rheumatic diseases of the heart		Diseases of the heart (all forms)		Acute rheumatic fever		Chronic rheumatic diseases of the heart		Diseases of the heart (all forms)	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Under 5 years												
West South Central	4	4	13	15	128	115	2	6	8	3	34	33
Arkansas	------	1	3	3	12	15	------	1	2	1	6	4
Louisiana	------	1	------	1	12	8	1	2	5	1	14	14
Oklahoma	1	1	3	1	19	30	------	------	1	1	6	5
Texas	3	1	7	10	85	62	1	3	------	------	8	10
5–9 years												
West South Central	22	33	27	23	65	49	5	8	13	11	27	24
Arkansas	1	3	4	3	8	5	------	1	1	------	3	2
Louisiana	3	2	5	3	7	7	3	3	8	5	13	10
Oklahoma	5	11	5	5	15	12	1	------	------	1	1	2
Texas	13	17	13	12	35	25	1	4	4	5	10	10
10–14 years												
West South Central	26	25	43	46	91	101	8	10	25	18	46	41
Arkansas	9	4	8	4	14	7	1	------	2	2	6	6
Louisiana	2	1	4	10	8	18	5	5	11	9	17	17
Oklahoma	4	8	15	9	26	18	------	------	4	1	6	4
Texas	11	12	16	23	43	58	2	5	8	6	17	14
15–19 years												
West South Central	25	14	63	43	155	125	4	8	15	15	49	66
Arkansas	4	1	10	5	13	14	------	1	4	1	11	9
Louisiana	1	------	7	8	22	14	4	1	3	9	15	33
Oklahoma	6	4	19	15	32	28	------	1	1	1	4	3
Texas	14	9	27	15	88	69	------	5	7	4	19	21

The high mortality of the nonwhite girls 15–19 years old in Louisiana causes a marked deviation from the division's average (16.6), the difference of -7.7 ± 2.83 being nearly three times its standard error. In the white group 15–19 years old the only difference approaching statistical significance ($+4.2 \pm 1.88$) is between the surprisingly low mortality of the boys in Arkansas (5.5) and the group average (9.7). All other deviations of the two racial groups from the respective averages of the division are small or lie within the boundaries of simple chance variation.

Table 18.—Population under 20 years, by age, race, and sex: *West South Central* and individual States, Census of 1940

Area	White		Nonwhite		White		Nonwhite	
	Male	Female	Male	Female	Male	Female	Male	Female
	Under 5 years				5–9 years			
West South Central	494, 692	479, 474	124, 082	124, 887	502, 509	487, 162	128, 785	129, 600
Arkansas	74, 674	72, 669	24, 932	25, 227	75, 688	73, 589	25, 477	25, 519
Louisiana	70, 305	68, 581	46, 048	45, 693	70, 054	67, 990	44, 791	45, 141
Oklahoma	100, 264	96, 149	11, 347	11, 566	102, 656	98, 946	12, 319	12, 404
Texas	249, 449	242, 075	41, 755	42, 401	254, 111	246, 637	46, 198	46, 536
	10–14 years				15–19 years			
West South Central	533, 659	518, 025	130, 918	132, 211	535, 258	530, 772	124, 046	132, 380
Arkansas	78, 847	76, 315	25, 577	25, 601	78, 341	76, 965	24, 064	25, 543
Louisiana	77, 586	75, 369	45, 239	45, 642	76, 644	76, 577	41, 842	45, 335
Oklahoma	107, 485	103, 950	12, 876	12, 921	108, 889	106, 725	12, 699	12, 751
Texas	269, 741	262, 391	47, 226	48, 047	271, 384	270, 505	45, 441	48, 751

Mountain States

The eight Mountain States: Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, and Nevada, are all sparsely populated, occupying a large territory on the high plateau of the western mountain range stretching from north to south throughout the United States. The numbers in these States, even of the white children, are relatively small. In none of them except Colorado is the standard of 100,000 person-years reached for the single age-sex groups under examination. In Nevada the white population seldom runs above 4,000 in the respective groups in the census year and, therefore, is much too small to yield reliable rates even in 3 years of observation. The nonwhite population, consisting in the majority of Indians, is extremely small in most of these States; thus trustworthy rates cannot be obtained even for the total division, as will easily be seen from the bracketed figures. The death rates and deaths are given in table 19 (a and b); the population by age, race, and sex, in table 20.

It will be recalled from the former discussion on the geographic divisions that mortality from heart diseases is very high for the white children in the Mountain division. As a matter of fact, disregarding the age group under 5, it is the highest among all divisions except in the age group 15–19, where it is second only to the higher mortality rates in the Middle Atlantic. The white population of the Mountain division differs from the white population in other regions in that it contains a large proportion of persons of Mexican origin who in general also experience high infant mortality rates and high rates for other causes of death, such as tuberculosis. The unequal operation of socio-economic factors among the white population in the Mountain States may contribute also to the high mortality from rheumatic fever and heart diseases.

The sex differences are not significant in any age group for the division as a whole nor for Colorado, the only State having a population large enough to yield reliable rates. Even the large sex difference in Colorado for the 15 to 19 year olds with 5.9 ± 4.35, in favor of the girls (male rate 17.2; female 11.3) is not statistically significant, though confirming the general trend for the white population in the total division and the total United States. All other sex differences in the 15–19 year-old group likewise fall within

Table 19a.—Mortality from acute rheumatic fever, chronic rheumatic diseases of the heart, and diseases of the heart (all forms) in persons under 20 years, by age, race, and sex: *Mountain* and individual States, 1939–41

A. AVERAGE ANNUAL RATES PER 100,000

Area	White						Nonwhite					
	Acute rheumatic fever		Chronic rheumatic diseases of the heart		Diseases of the heart (all forms)		Acute rheumatic fever		Chronic rheumatic diseases of the heart		Diseases of the heart (all forms)	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Under 5 years												
Mountain	1.0	0.7	1.4	1.6	6.0	6.7	[0]	[0]	[0]	[0]	[0]	[8.9]
Montana	[2.9]	[0]	[0]	[1.5]	[2.9]	[5.9]	------	------	------	------	------	------
Wyoming	[0]	[0]	[0]	[0]	[2.9]	[3.1]	------	------	------	------	------	------
Idaho	[1.3]	[1.3]	[1.3]	[2.6]	[6.3]	[6.6]	------	------	------	------	------	------
Colorado	1.4	0	2.7	1.4	7.6	7.1	------	------	------	------	------	------
New Mexico	[1.1]	[1.2]	[1.1]	[0]	[4.6]	[8.1]	------	------	------	------	------	------
Arizona	[0]	[1.6]	[0]	[1.6]	[6.1]	[7.8]	------	------	------	------	------	------
Utah	[0]	[1.2]	[2.3]	[3.5]	[6.8]	[7.0]	------	------	------	------	------	------
Nevada	[0]	[0]	[0]	[0]	[15.3]	[0]	------	------	------	------	------	------
5–9 years												
Mountain	2.9	2.9	4.2	5.2	8.1	8.3	[0]	[0]	[6.5]	[3.1]	[6.5]	[6.3]
Montana	[4.6]	[3.2]	[1.5]	[4.8]	[7.6]	[9.6]	------	------	------	------	------	------
Wyoming	[6.2]	[3.2]	[6.2]	[0]	[6.2]	[0]	------	------	------	------	------	------
Idaho	[1.4]	[1.4]	[4.1]	[4.3]	[8.3]	[7.1]	------	------	------	------	------	------
Colorado	2.1	.7	5.7	10.2	10.0	13.9	------	------	------	------	------	------
New Mexico	[3.6]	[0]	[1.2]	[3.6]	[5.9]	[4.8]	------	------	------	------	------	------
Arizona	[1.6]	[4.9]	[0]	[1.6]	[3.2]	[3.2]	------	------	------	------	------	------
Utah	[3.5]	[3.7]	[9.4]	[4.9]	[13.0]	[8.5]	------	------	------	------	------	------
Nevada	[0]	[0]	[0]	[0]	[0]	[18.1]	------	------	------	------	------	------
10–14 years												
Mountain	3.5	2.5	8.1	10.7	13.0	15.4	[0]	[7.2]	[0]	[7.2]	[14.2]	[7.2]
Montana	[1.4]	[1.5]	[4.3]	[11.9]	[4.3]	[17.8]	------	------	------	------	------	------
Idaho	[4.0]	[2.7]	[8.0]	[13.7]	[10.6]	[15.1]	------	------	------	------	------	------
Wyoming	[0]	[0]	[6.0]	[6.2]	[12.0]	[6.2]	------	------	------	------	------	------
Colorado	6.2	4.2	11.7	14.0	17.9	20.3	------	------	------	------	------	------
New Mexico	[2.5]	[3.7]	[8.6]	[6.2]	[17.2]	[7.5]	------	------	------	------	------	------
Arizona	[1.6]	[1.6]	[1.6]	[6.5]	[3.1]	[11.3]	------	------	------	------	------	------
Utah	[4.6	[1.2]	[11.5]	[12.0]	[19.5]	[21.6]	------	------	------	------	------	------
Nevada	[0]	[0]	[0]	[0]	[0]	[0]	------	------	------	------	------	------
15–19 years												
Mountain	2.9	1.9	9.5	6.7	17.2	14.1	[3.9]	[0]	[11.6]	[4.0]	[34.7]	[8.0]
Montana	[1.3]	[1.4]	[5.3]	[6.9]	[17.2]	[18.1]	------	------	------	------	------	------
Idaho	[2.6]	[2.6]	[11.5]	[4.0]	[16.6]	[6.6]	------	------	------	------	------	------
Wyoming	[2.7]	[0]	[5.4]	[11.9]	[13.5]	[14.8]	------	------	------	------	------	------
Colorado	6.0	2.7	7.9	7.3	17.2	11.3	------	------	------	------	------	------
New Mexico	[0]	[1.3]	[5.3]	[6.5]	[12.0]	[17.0]	------	------	------	------	------	------
Arizona	[1.6]	[0]	[6.5]	[3.2]	[6.5]	[9.7]	------	------	------	------	------	------
Utah	[1.1]	[3.5]	[23.0]	[8.2]	[32.2]	[18.9]	------	------	------	------	------	------
Nevada	[16.8]	[0]	[0]	[8.8]	[8.4	[43.3]	------	------	------	------	------	------

NOTE.—Rates are bracketed when based on a population group less than 100,000 in the 3 years under observation. Whenever this was the case for the total geographic division, rates are not shown at all for individual States.

Table 19b.—Mortality from acute rheumatic fever, chronic rheumatic diseases of the heart, and diseases of the heart (all forms) in persons under 20 years by age, race, and sex: *Mountain* and individual States, 1939–41

B. ABSOLUTE NUMBER OF DEATHS IN 3 YEARS

Area	White						Nonwhite					
	Acute rheumatic fever		Chronic rheumatic diseases of the heart		Diseases of the heart (all forms)		Acute rheumatic fever		Chronic rheumatic diseases of the heart		Diseases of the heart (all forms)	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
	Under 5 years											
Mountain	6	4	8	9	35	38	------	------	------	------	------	3
Montana	2	------	------	1	2	4	------	------	------	------	------	1
Idaho	1	1	1	2	5	5	------	------	------	------	------	1
Wyoming	------	------	------	------	1	1	------	------	------	------	------	------
Colorado	2	------	4	2	11	10	------	------	------	------	------	------
New Mexico	1	1	1	------	4	7	------	------	------	------	------	1
Arizona	------	1	------	1	4	5	------	------	------	------	------	------
Utah	------	1	2	3	6	6	------	------	------	------	------	------
Nevada	------	------	------	------	2	------	------	------	------	------	------	------
	5–19 years											
Mountain	16	11	23	28	45	45	------	------	2	1	2	2
Montana	3	2	1	3	5	6	------	------	1	------	1	------
Idaho	1	1	3	3	6	5	------	------	------	------	------	------
Wyoming	2	1	2	------	2	------	------	------	------	------	------	------
Colorado	3	1	8	14	14	19	------	------	1	------	1	------
New Mexico	3	------	1	3	5	4	------	------	------	------	------	------
Arizona	1	3	------	1	2	2	------	------	------	1	------	2
Utah	3	3	8	4	11	7	------	------	------	------	------	------
Nevada	------	------	------	------	------	2	------	------	------	------	------	------
	10–14 years											
Mountain	20	14	46	59	74	85	------	2	------	2	4	2
Montana	1	1	3	8	3	12	------	------	------	1	------	1
Idaho	3	2	6	10	8	11	------	1	------	------	------	------
Wyoming	------	------	2	2	4	2	------	------	------	------	1	------
Colorado	9	6	17	20	26	29	------	------	------	------	------	------
New Mexico	2	3	7	5	14	6	------	1	------	------	1	------
Arizona	1	1	1	4	2	7	------	------	------	------	2	------
Utah	4	1	10	10	17	18	------	------	------	1	------	1
Nevada	------	------	------	------	------	------	------	------	------	------	------	------
	15–19 years											
Mountain	17	11	55	38	99	80	1	------	3	1	9	2
Montana	1	1	4	5	13	13	------	------	------	------	1	------
Idaho	2	2	9	3	13	5	------	------	1	------	1	------
Wyoming	1	------	2	4	5	5	1	------	------	------	------	------
Colorado	9	4	12	11	26	17	------	------	1	------	1	------
New Mexico	------	1	4	5	9	13	------	------	------	1	1	1
Arizona	1	------	4	2	4	6	------	------	------	------	2	1
Utah	1	3	20	7	28	16	------	------	1	------	3	------
Nevada	2	------	------	1	1	5	------	------	------	------	------	------

Table 20.—Population under 20 years, by age, race, and sex: *Mountain* and individual States, Census of 1940

Area	White		Nonwhite		White		Nonwhite	
	Male	Female	Male	Female	Male	Female	Male	Female
	Under 5 years				5–9 years			
Mountain	194, 380	118, 250	11, 200	11, 233	184, 293	179, 946	10, 231	10, 615
Montana	23, 273	22, 610	1, 345	1, 353	21, 830	20, 881	1, 207	1, 295
Idaho	26, 350	25, 256	281	266	24, 118	23, 435	249	275
Wyoming	11, 324	10, 840	252	265	10, 728	10, 502	236	240
Colorado	48, 507	46, 940	592	621	46, 731	45, 722	603	649
New Mexico	29, 289	28, 757	2, 954	3, 001	28, 051	27, 806	2, 641	2, 658
Arizona	21, 771	21, 298	5, 052	5, 012	21, 019	20, 541	4, 589	4, 762
Utah	29, 501	28, 482	421	368	28, 236	27, 385	390	420
Nevada	4, 365	4, 067	303	347	3, 580	3, 674	316	316
	10–14 years				15–19 years			
Mountain	189, 383	183, 879	9, 407	9, 271	192, 265	188, 814	8, 646	8, 363
Montana	23, 438	22, 502	1, 092	1, 069	25, 146	23, 989	1, 022	979
Idaho	25, 082	24, 283	284	275	26, 040	25, 168	347	311
Wyoming	11, 131	10, 755	228	218	12, 356	11, 228	227	191
Colorado	48, 489	47, 708	687	734	50, 332	50, 236	828	748
New Mexico	27, 160	26, 735	2, 283	2, 257	24, 944	25, 516	1, 940	1, 901
Arizona	21, 314	20, 584	4, 047	3, 945	20, 471	20, 544	3, 568	3, 487
Utah	29, 031	27, 747	497	487	28, 998	28, 285	460	477
Nevada	3, 738	3, 565	289	286	3, 978	3, 848	254	269

chance limits, including the extreme differences in Utah and Nevada which are, besides, in opposite directions. The highest difference, 34.9 ± 21.10, which is in Nevada (male 8.4; female 43.3) and the inverse sex difference of 13.3 ± 7.70 in the larger population of Utah (male 32.2; female 18.9), both lie within chance boundaries.[2]

Since most State-to-State variations and sex differences can be explained by mere chance, it is worth mentioning that in Colorado, the State with the largest population, mortality from heart diseases surpasses in most instances even the high average mortality of the Mountain division. For the girls 5–9 years old, the deviation of the high death rate in Colorado (13.9) from the average (8.3) approaches statistical significance (-5.6 ± 2.12). In other instances the deviations in Colorado from the group total are not significant, but in all ages they are above average except in the 15–19 year-old group where the girls have a slightly below-average death rate.

There is one more item of significance regarding the rates in the Mountain States. This is the consistently low mortality from heart diseases in Arizona and the consistently high mortality in Utah, evident in all three age groups from 5 through 19, and especially pronounced in the males. Although the population does not reach 100,000 person-years, these differences are so great and consistent that they cannot be attributed to chance. Treating the two States as independent samples, we obtain the following values for the differences:

[2] It is obvious that the level of the death rates (the probabilities of the event) as well as the population numbers exposed determine the magnitude of the errors. The error function is inversely proportional to the population at risk and, therefore, weighs more heavily in the small population of Nevada, as the above sample demonstrates.

Death rates for mortality from diseases of the heart (all forms) in Arizona and Utah, their differences and standard errors, 1939–41; White children

	5–9 years		*10–14 years*		*15–19 years*	
	Male	*Female*	*Male*	*Female*	*Male*	*Female*
Arizona	3. 2	3. 2	3. 1	11. 3	6. 5	9. 7
Utah	13. 0	8. 5	19. 5	21. 6	32. 2	18. 9
Difference	9.8 ± 4.52	5.3 ± 3.94	16.4 ± 5.22	10.3 ± 6.65	25.7 ± 6.90	9.2 ± 6.16

In all instances the differences for the boys approach or reach significance; for the 10–14 year olds (16.4±5.22) and the 15–19 year olds (25.7±6.90) they are more than three times the respective standard errors. The girls also show the same trend, as the summary demonstrates. Thus there must be some other explanation than chance for the strikingly low mortality from rheumatic fever and heart diseases in Arizona and the strikingly high mortality in Utah. Population factors can hardly explain these differences (Arizona having a much higher proportion of persons of Mexican origin than Utah) nor can climatic factors in the two neighboring States. Similar findings have been mentioned by former investigators of the rheumatic fever problem and they merit a more thorough examination.

As is only natural, the extremely low rates in Arizona and the extremely high rates in Utah cause high deviations from the averages in the Mountain division which, though running in opposite directions, also approach statistical significance in several instances. In particular the high mortality for the 15–19 year-old boys in Utah (32.2), highest for white boys among all States, challenges the attention of the public health workers and local physicians. This rate surpasses by a margin of 15.0±4.11 (which is almost four times its error), the already high group average (17.2) of this division. (The still higher rate for the girls in Nevada in this age group, 43.3, is based on too small a population to be of statistical significance.)

Pacific States

The three States on the Pacific coast: Washington, Oregon, and California, have large enough white populations for computing age and sex specific rates in a 3-year observation without in each case adding the chance errors. California, being one of the most populated and rapidly growing States in the Union, carries by far the greatest weight among the three and therefore determines to a large degree the over-all rates of the division. The nonwhite population in the Pacific States is relatively small and consists, in rank order, of Negroes, Japanese, Chinese, Filipinos, and Indians. Even for the division as a whole the rates of the nonwhite children cannot be considered stable enough (bracketed figures). The death rates and deaths for the 3 years 1939–41 are shown in table 21 (a and b) and the census population by age, race, and sex in table 22.

Concentrating again on mortality from heart diseases (all forms), it will be recalled that the over-all death rates in the Pacific division are in most instances significantly below the average rates in the total United States (see tables V and VII). Though the rates for the nonwhite children are not stable enough, there is a certain tendency for them to show higher mortality rates from rheumatic fever diseases than the white children. The death rates for the white children in the total division are very low in the age group 5–9 (3.6 and 4.9 for boys and girls respectively), and go up somewhat in the following age groups 10–14 (5.6 and 6.2) and 15–19 (9.1 and 6.7).

Within the Pacific States in almost all instances, for the age groups 5 through 19 years, mortality from heart diseases is higher in Oregon and lower in California than in the total division, Washington being between and usually closer to the average. The sex differences are not consistent and not significant in the division as a whole, nor in the individual States. On the other hand, the high deviations in Oregon from the average rates in the division reach statistical significance in quite a few instances: for the 5–9 year-old boys, −4.6±1.70; the 5–9 year-old girls, −5.5±2.01; and still more for the 10–14 year-old girls, −7.3±2.14. The inverse holds for the low mortality rates in California which are based on much larger population numbers. (Small differences, therefore, have greater meaning in California than in Oregon.) The deviations from the average rates for the division approach significance in California for the boys and girls 5–9 years of age, for the girls 10–14 years, and for the boys 15–19 years old. A short summary of the differences from the division's average in Oregon and California is given in the following tabulation, which also shows the arithmetic values for the other age groups:

Differences in mortality from diseases of the heart (all forms) between Pacific and Oregon, and Pacific and California, 1939–41: White children

	5–9 years		10–14 years		15–19 years	
	Male	Female	Male	Female	Male	Female
Oregon	−4.6±1.70	−5.5±2.01	−.1±2.00	−7.3±2.14	−3.3±2.43	−2.9±2.09
California	+.9± .42	+1.3± .50	−.1± .50	+1.1± .54	+1.4± .61	+.4± .52

In all instances higher mortality is indicated in Oregon (—sign) and in all except one, lower mortality in California (+ sign). The one exception for California, boys 10–14 years, has no significance, the rates in both States being the same (5.7) and hardly differing from the average (5.6) for the division. This contrast between the mortality from heart diseases among children in Oregon and in California deserves to be studied more closely. It does not seem as if this could be explained by differences in climatic conditions along the Pacific coast; or by less adequate reporting and diagnosis in California; or by population density which is lower in Oregon, the State with the higher mortality.

Table 21a.—Mortality from acute rheumatic fever, chronic rheumatic diseases of the heart, and diseases of the heart (all forms) in persons under 20 years, by age, race, and sex: *Pacific* and individual States, 1939–41

A. AVERAGE ANNUAL RATES PER 100,000

Area	White						Nonwhite					
	Acute rheumatic fever		Chronic rheumatic diseases of the heart		Diseases of the heart (all forms)		Acute rheumatic fever		Chronic rheumatic diseases of the heart		Diseases of the heart (all forms)	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
	Under 5 years											
Pacific	0.3	0.7	0.5	0.3	5.4	4.1	[0]	[0]	[0]	[0]	[10.9]	[2.8]
Washington	0	.6	.5	.6	8.2	3.4	------	------	------	------	------	------
Oregon	.9	.9	1.7	0	7.0	4.5	------	------	------	------	------	------
California	.3	.6	.3	.3	4.4	4.2	------	------	------	------	------	------
	5–9 years											
Pacific	0.9	1.6	1.8	2.3	3.6	4.9	[2.6]	[0]	[5.2]	[5.3]	[10.5]	[5.3]
Washington	1.7	3.0	1.7	3.0	4.0	6.0	------	------	------	------	------	------
Oregon	0	1.9	3.6	5.7	8.2	10.4	------	------	------	------	------	------
California	.8	1.1	1.4	1.5	2.7	3.6	------	------	------	------	------	------
	10–14 years											
Pacific	2.0	1.6	3.6	3.4	5.6	6.2	[2.1]	[2.2]	[4.2]	[8.9]	[6.4]	[11.2]
Washington	2.6	2.2	3.2	3.8	5.3	5.4	------	------	------	------	------	------
Oregon	1.6	5.0	4.1	8.4	5.7	13.5	------	------	------	------	------	------
California	1.9	.9	3.6	2.4	5.7	5.1	------	------	------	------	------	------
	15–19 years											
Pacific	0.9	0.7	4.2	3.2	9.1	6.7	[3.4]	[1.9]	[5.1]	[11.5]	[18.7]	[19.2]
Washington	.9	1.0	6.9	1.9	12.0	6.2	------	------	------	------	------	------
Oregon	.7	1.5	5.8	4.4	12.4	9.6	------	------	------	------	------	------
California	.9	.5	3.2	3.3	7.7	6.3	------	------	------	------	------	------

NOTE.—Rates are bracketed when based on a population group less than 100,000 in the 3 years under observation. Whenever this was the case for the total geographic division, rates are not shown at all for individual States.

Table 21b.—Mortality from acute rheumatic fever, chronic rheumatic diseases of the heart, and diseases of the heart (all forms) in persons under 20 years by age, race, and sex: *Pacific* and individual States, 1939–41

B. ABSOLUTE NUMBER OF DEATHS IN 3 YEARS

Area	White						Nonwhite					
	Acute rheumatic fever		Chronic rheumatic diseases of the heart		Diseases of the heart (all forms)		Acute rheumatic fever		Chronic rheumatic diseases of the heart		Diseases of the heart (all forms)	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
	Under 5 years											
Pacific	3	6	5	3	52	38	------	------	------	------	4	1
Washington	------	1	1	1	15	6	------	------	------	------	1	1
Oregon	1	1	2	------	8	5	------	------	------	------	------	------
California	2	4	2	2	29	27	------	------	------	------	3	------
	5–9 years											
Pacific	8	14	16	20	33	43	1	------	2	2	4	2
Washington	3	5	3	5	7	10	------	------	------	1	1	1
Oregon	------	2	4	6	9	11	------	------	1	------	1	------
California	5	7	9	9	17	22	1	------	1	1	2	1
	10–14 years											
Pacific	20	16	36	33	56	60	1	1	2	4	3	5
Washington	5	4	6	7	10	10	1	------	1	2	2	3
Oregon	2	6	5	10	7	16	------	------	------	------	------	------
California	13	6	25	16	39	34	------	1	1	2	1	2
	15–19 years											
Pacific	10	8	48	35	103	74	2	1	3	6	11	10
Washington	2	2	15	4	26	13	------	------	2	------	2	1
Oregon	1	2	8	6	17	13	------	------	1	------	1	------
California	7	4	25	25	60	48	2	1	------	6	8	9

Table 22.—Population under 20 years by age, race, and sex: *Pacific* and individual States, census of 1940

Area	White		Nonwhite		White		Nonwhite	
	Male	Female	Male	Female	Male	Female	Male	Female
	Under 5 years				5–9 years			
Pacific	320, 072	307, 480	12, 206	11, 763	304, 574	295, 109	12, 737	12, 643
Washington	60, 737	58, 331	1, 414	1, 436	57, 836	55, 939	1, 500	1, 487
Oregon	38, 283	36, 750	554	522	36, 788	35, 340	518	563
California	221, 052	212, 399	10, 238	9, 805	209, 950	203, 830	10, 719	10, 593
	10–14 years				15–19 years			
Pacific	333, 758	324, 171	15, 708	14, 907	377, 206	369, 548	19, 562	17, 368
Washington	63, 113	61, 163	1, 795	1, 771	72, 212	69, 839	2, 542	2, 132
Oregon	40, 984	39, 613	701	689	45, 588	45, 201	791	778
California	229, 661	223, 395	13, 212	12, 447	259, 406	254, 508	16, 229	14, 458

Appendix C

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